

The Chemical Age

A Weekly Journal Devoted to Industrial and Engineering Chemistry

VOL. XLVIII
No. 1227

SATURDAY, JANUARY 2, 1943
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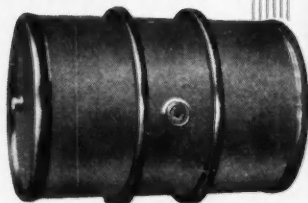
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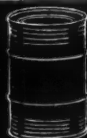
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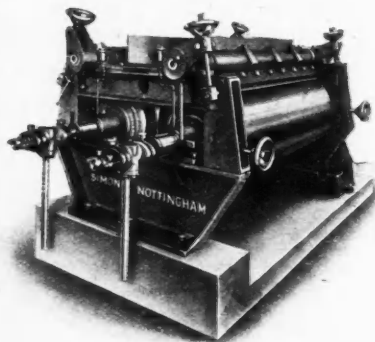
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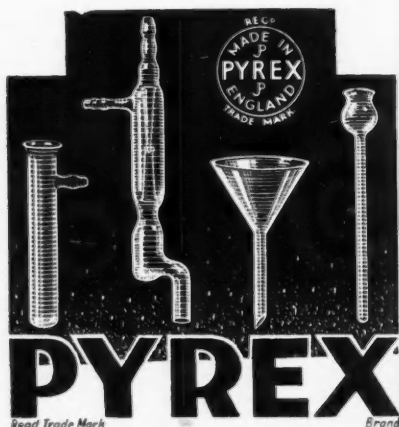
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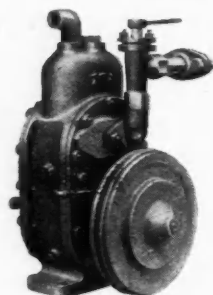
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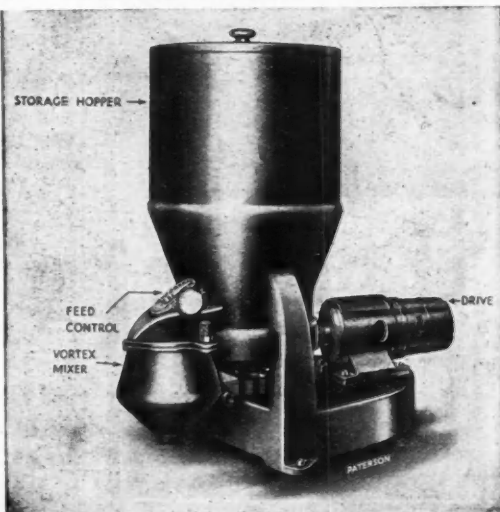
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VOL. XLVIII
No. 1227

January 2, 1943

Annual Subscription, 21s.
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The Electro-Chemical Industries

THE Scottish Hydro-Electric Scheme which was turned down some little time ago by Parliament, on the ground that private companies should not interfere with the natural beauty of the Highlands, has now been revived by the publication of a report by the Committee on Hydro-Electric Development in Scotland. The Committee recommends setting up a public service corporation comprising a Board domiciled in that country, and responsible for initiating and undertaking the development of all further generation of electricity in the Northern area for public supply, and its transmission in bulk to the existing undertakers. A summary of the report was contained in THE CHEMICAL AGE for December 19.

To the chemical industries, the essential importance of this proposal lies in the three primary objectives laid down for the development programme of the Board, namely:

- (a) to attract to the Highlands through the offer of cheap and abundant power a share in the vital and expanding electro-chemical and electrometallurgical industries;
- (b) to develop such further

power as may be required for the consumers of existing undertakings or for consumers in its own distribution area, the surplus being exported to the grid; and

- (c) to develop on an experimental and demonstrational basis isolated schemes in isolated districts.

The recognition that the electrochemical and electro-metallurgical industries are "vital" is long overdue. Parliament in its wisdom decreed that natural amenities were more vital than industrial development. It is not yet certain, of course, that Parliament will reverse this decision, but it may well take a more realistic view to-day. In our opinion, there need be no divergence of achievement. The natural beauties can be preserved without interfering with

industrial development, if there is commonsense and good will on all sides. If this can all be achieved and in addition a Tennessee Valley scheme of our own can convert a sparsely populated region into a happy, prosperous area, we shall have another example of the beneficial effect of chemical industry on social progress. The importance of the development of water-power must be viewed against the background of coal con-

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servation. We suppose that few technologists, to-day, would deny this paramount necessity.

The use of electricity for heating purposes is hedged about with economic difficulties. If coal, for example, is used as the basis for generating current, the coal must first be burnt and converted into heat. The heat must be transmitted to water and the water converted into steam; heat transmission is not a particularly efficient process unless the greatest care is taken to keep the conditions right. If this steam is directly used to produce heat or as a heating medium, as in distillation, evaporation, etc., the over-all loss is considerable, but not excessive.

When electricity is used for heating, however, the steam must first be converted into electricity, a process which is known to be very inefficient thermally. The thermal efficiency of the very best power stations is only of the order of 25 to 27 per cent.—though 30 per cent. is not outside the bounds of possibility in the newest "super" power stations, if we are correctly informed. The usual thermal efficiency of power generation is well below these figures, however, and by the time the electricity has been generated, some 80 per cent. of the heat in the coal has been lost. There are further losses in transmission lines, and in transformers, so that by the time the current reaches the process, the cost in coal is pretty considerable. Then follows the anticlimax, when all that is done with the current is to re-convert it into heat. Thus the net result of all these processes is to convert coal into heat, to convert the heat into electricity with enormous losses, and then to re-convert the electricity back into heat. It seems a highly foolish proceeding, but its justification lies in the fact that heat in the form of electricity may perform work that could not possibly be performed equally well, or perhaps not even at all, by heat in other forms. Whatever may be the justification, it is evident that that justification will be still greater if the electricity can be obtained from some non-wasting asset, such as water-power. The Severn Barrage scheme was widely discussed some ten years ago with this objective in view, and unfortunately was dropped. It might still be revived with some advantage in the light of post-war needs.

To all these considerations, one contrary one must be advanced, namely that off-peak current can be used with advantage when current produced specially for the purpose would be uneconomic. There may be solid advantages in finding a use for current that would otherwise be wasted. Thus, in Canada electricity has been used even for such relatively "low-grade" heating purposes as carbonising coal. This is off-peak current that would otherwise be wasted, and the operations are generally confined to the night, when no other use is available. If electro-chemical industries could be based on off-peak current, they could be more generally adopted. There is a great deal of this current available. The difficulty is that expensive plant must be installed and allowed to stand idle for long periods of the day, so that the whole proceeding becomes uneconomic. Consequently, the conclusion is reached that any considerable extension of electro-chemical industries in Great Britain, as a peace-time policy, must be based upon water-power.

Development of water-power in this country is rendered difficult, as we have said, by the conflicting claims of those who would develop industry and those who would preserve the natural amenities of beautiful scenery. Unfortunately, the Black Country of a past generation shows only too clearly what industrial development at its worst can do to the countryside. There is no need for an industrialised country to be turned into a Black Country, and that is truer in normal times at this period of industrial practice than ever before, when transport is available to remove unsightly dumps, and when science is at work to make as certain as possible that no by-product shall be wasted. Even blast-furnace slag—once the component of slag heaps—is now utilised; the Ministry of Fuel will doubtless find a use for pit-head dumps in due course. A very great deal must depend on the way in which industry deals with its materials and by-products. Works can be planned to fit into the countryside without being an eyesore, and to avoid accumulations of rubbish. It will be the task of the Hydro-Electric Board, if it is set up, to see, in conjunction with industry, that electro-chemical developments in the Highlands present to the world a model of what such works should be.

NOTES AND COMMENTS

Industry's Task in 1943

IN a New Year message, Lieut.-Colonel Lord Dudley Gordon, President of the Federation of British Industries, says: "Industry in the coming year has one over-riding task—to keep steadily on, making the utmost of the country's resources in machines and man-power. The recent heartening successes in the field will spur us on with renewed zest. The fact that industry in Britain in 1942 achieved an output in proportion to the population greater than that of any other country, reflects the measure of success that has attended the nation's immense concentration and organisation of industrial effort. The coming year will see the continued mustering of the allied forces of production. With an ever-accumulating weight of material and trained man-power in action, we can look to the end, whenever it may come, with confidence. Peace, we know, will bring its problems. But if we can face them with the energy and spirit that have governed us in these stern years, those problems will not prove insuperable."

Compulsory Fuel Economy

WHERE voluntary control is not effective, compulsion has perforce to step in, in these days of emergency. Consumers of fuel cannot complain that they have had insufficient warning of the urgent necessity for fuel economy, and the issue of the Control of Fuel (No. 3) Order, which came into force on New Year's Day, is part of a logical sequence, consolidating and revoking the previous Waste of Fuel Order and Control of Fuel Order. The Order empowers the Minister of Fuel to control the use of fittings or appliances which consume fuel, to the extent of directing how these may be used, and even of prohibiting their use. Persons authorised by the Minister are given the right to enter and inspect premises, and to inspect and test fuel fittings and appliances—an extension of the right to enter in order to detect waste—and proceedings may be taken against the occupier of premises in which an unreasonable quantity of fuel has been used over a given period. While we all have an instinctive dislike of official prying into our private affairs, we are forced to admit that the new Order is likely to prove a check on those unscrupulous per-

sons who have taken advantage of their neighbours' economy in fuel and have gone on merrily using their own "regardless." Any consumers who have been sailing too near the wind will do well to put matters right before it is too late.

South African Pottery

INDUSTRIALLY speaking, one of the most interesting aspects of this war, as of the last, is the effect that it has had of reviving local manufactures, which, under normal conditions of international trade, have not found it possible to compete in the open market. Among the latest instances of this kind that has been brought to our notice is the South African white earthenware industry, in abeyance since 1914. The Consolidated Rand Brick, Pottery, and Lime Company has announced its intention of restarting the whiteware works at Olifantsfontein in order to cope with the present scarcity of pottery in the Union. The raw materials, of varying grades, are discoverable in different parts of the country. Kaolin, resulting from the alteration of various feldspathic elements, is found in a number of locations on the Rand and, somewhat inaccessibly, in Namaqualand; ball clay is on the spot at Olifantsfontein; spodumene, a valuable glazing flux, is also produced in Namaqualand; and quartz of good quality, to pulverise for silica, is available in the Transvaal. Experience in dealing with local material is plentiful, and it will be interesting to watch future developments.

Coal Research in Durham

COMMENTING on the million-pound coal research scheme outlined by Sir Evan Williams, Professor Granville Poole, of the Mining Dept. of King's College, Newcastle-upon-Tyne, called attention to the fact that every coal seam in the North of England had been analysed by his department during the past 10 years. Durham should not, in his view, export its best coking coal as it had done in the past, but more research should be applied to the blending of coal. Good coking coals should be mixed with poorer coking coals or even with non-coking coals, in order to produce a much greater supply of liquid fuel, lubricants and other by-products, and much more coke and gas.

The North African Scene

THIS is in no way the place to discuss the pros and cons of the military strategy of the Allied Forces; but an occasional review of the economic results of such strategy does not come amiss. If we look at the North African scene, at the present juncture, advantages positive and negative are plainly to be discerned. The negative advantage is the denial to the enemy of the rich phosphate-rock deposits of the French possessions there. It is widely known that the well-used soils of the Continent of Europe require, and require absolutely, a continuous supply of phosphoric oxide if they are to maintain their productivity—about 36 lb. to the acre is the calculated amount necessary. For Germany alone it has been reckoned that two million tons P_2O_5 are needed annually, and only about half of this can be provided by the German blast furnaces in the form of basic slag. The rest must be imported, and the sudden cutting-off of the North African supplies is bound to have an adverse effect on the fertility of the soil of Europe, hence on the Nazi food supplies.

A New Trade Agreement

THE positive advantages are, of course, more obvious: iron, lead, zinc, and cobalt ores abound in Morocco and Algeria; the cork harvest is second only to that of the Iberian peninsula; and the other vegetable and animal products are of the highest importance, notably the output of oil-bearing plants of a wide diversity of species. Moreover, the position of French North Africa has been abnormal in many respects since the fall of France in 1940. Many of the most enterprising Frenchman, not wishing to contribute to the power of Germany, transferred themselves, their brains, and their capital from the mother country to the colonies across the Mediterranean, with the result that the resources of North Africa have been examined with greater care than for many years past, and their development put in hand eagerly and seriously. Now comes the new agreement, mentioned elsewhere in this issue, whereby Britain and the United States have arranged to take as their share of the produce of North Africa a modicum of those items of which they are most in need. In return for this the Allied Powers will supply North Africa with many of the commodities of

which she has gone short during the years of France's subjection. Such an arrangement should be mutually satisfactory and will undoubtedly go a long way towards starving the Nazi beast of the fodder which he insatiably demands.

Reaction from Specialisation

THE destruction of buildings and property wrought by the Nazis in Europe, immense as it is, can still be calculated in terms of labour and material. Certainly, works of architectural art and traditional shrines will be missed, but the loss even of these is not so serious as the results of the cold-blooded policy of the annihilation of culture which has been pursued by Hitler's terrorists. The restoration of cultural life in the Nazi-occupied countries is being given attention by a committee of distinguished men which has presented an interim report on Post-War University Education to the Council of the British Association. In the report there is fresh evidence of the reaction against specialisation which has been a feature of recent pronouncements from leaders in our intellectual and scientific life. The warning must be heeded: the student must be allowed to develop an interest in the community which he is learning to serve. To further this necessary change in education, members of the committee considered two proposals.

Broader Basis of Science

THE first proposal was for a type of degree course, including both natural science and the humanities, which would seek to provide an outlook on the modern world as seen as an integrated whole against a background of natural science. The second was a proposal for the inclusion in existing specialised honours schools of courses in the elements of sociology and citizenship. At present, the committee points out, a student is apt to devote his whole time to science and gains little, if any, knowledge of world affairs or of the government even of his own country and locality. These proposals must be linked up with Sir John Russell's and subsequent criticisms of the scientific worker who is too immersed in narrow problems to give the world the full benefit of his discoveries. Here is a case for imaginative planning in education. We hope to hear more of the recommendations.

Recent Developments in Analytical Chemistry—IV

(From our Analytical Correspondent)

Alloys

THE estimation of aluminium in magnesium alloys may be carried out either gravimetrically or colorimetrically. In the former method¹ use is made of the fact that precipitation of the aluminium from a solution in acetic acid, by means of ammonium benzoate solution, will separate that metal from magnesium, and from other metals, such as zinc and manganese, which are likely to be present. The resulting aluminium benzoate, which is dissolved up in ammoniacal tartrate solution, may then be precipitated using 8-hydroxyquinoline, since the metals which would interfere with this method of estimation are no longer present. If a colorimetric estimation is preferred, a dyestuff of the triphenylmethyl series, eriochrome-cyanine-R, is stated² to give, in a sodium acetate-acetic acid solution, a violet coloration which is suitable for estimation of the aluminium by comparison with a standard, using a yellow filter. Aluminium, when present in manganese bronzes or aluminium bronzes, can be separated completely from iron, manganese, lead, zinc, nickel and copper.³ Using acetic acid as electrolyte, and a mercury cathode, these metals are either deposited in the mercury as amalgams, or on the anode (e.g., lead). It is then a simple matter to estimate the aluminium remaining in the solution, either by the 8-hydroxyquinoline method or, if preferred, by precipitation as hydroxide and ignition to oxide.

Nickel Alloys: A routine method which enables silicon, manganese, chromium, nickel, copper and iron, as well as less usual constituents, to be estimated in alloys such as electrical heat-resistant alloys, has been worked out.⁴ The alloy is dissolved in hot 70 per cent. perchloric acid. Silica, which is left undissolved, is filtered off, washed, ignited and weighed. The filtrate is then made up to a known volume, and aliquot parts of this are used for several of the determinations. In one portion manganese is treated with silver nitrate in a sulphuric acid-phosphoric acid solution, followed by persulphate.

The resulting permanganate is estimated by an arsenite-nitrite titration. It is most suitable to titrate potentiometrically against ferrous ammonium sulphate to obtain a measure of the chromium content. A cyanide titration gives the nickel value. For the determination of copper and iron a fresh sample is electrolysed, the deposited copper being weighed: and a permanganate titration on the residual electrolyte gives the iron figure.

Tin alloys.—Antimony and copper may be estimated in tin-base bearing metal using only one sample.⁵ By digestion with sulphuric acid in the presence of potassium sulphate, the antimony and copper are both dissolved. The solution is directly titrated with permanganate, which gives the antimony content (along with any arsenic which may be present). After this titration the solution is first neutralised with ammonia, and the pH is then adjusted to 2.5-2.7 with sulphuric acid. An iodine-thiosulphate titration then serves for the determination of copper.

In this connection, the recommended use of a three-necked distilling flask for the iodometric estimation of tin should be mentioned.⁶ In order to maintain an inert atmosphere, a long lead-in tube A (Fig. 1), carried through one of the side necks to the bottom of the flask, serves for the entry into the liquid of carbon dioxide from a Kipp's apparatus or other suitable generator.

Passage of the gas in this way also stirs the liquid during the course of the titration. The burette is inserted through the central neck B. Attached to the other side neck C, is an air condenser 15 to 20 cms. long. This allows for the escape of the carbon dioxide, while ensuring that the flask remains filled with the inert gas. A secondary function

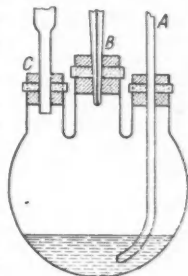


Fig. 1.

of the condenser is to permit the addition of necessary reagents such as potassium iodide during the titration. It is obvious that this set-up should be satisfactory for many other operations where an inert atmosphere is desired.

Indium alloys.—Methods stated to be satisfactory for the estimation of indium alloyed with zinc, lead and aluminium have been developed.⁷ The accuracy claimed is about ± 0.1 - 0.2 per cent. Work on alloys of indium with tin have failed to give a method which can improve on an accuracy of ± 1 per cent.

Minerals

Combining known macro and micro techniques, and working on the basis of analytical methods already utilised, a gravimetric procedure has been developed for the estimation of minute amounts of barium and strontium in silicate minerals.⁸ The mineral (as much as 10-15 g. if the expected amount of alkaline earth warrants it) is first broken down by the use of hydrofluoric acid. By a process of concentration in the form of sulphates, the barium and strontium are separated from most of the rest of the material, and are fused with sodium carbonate. The fused mass is treated to convert the alkaline earth metals to nitrates: and using micro technique the nitrates are extracted with nitric acid (sp. gr. 1.45). Calcium nitrate is thus leached out, the other two alkaline earth nitrates being insoluble. Finally, the barium is separated from the strontium, and each determined, using the chromates—a normal macro method.

In a scheme of analysis for titanium minerals,⁹ the sodium salt of *p*-hydroxy-phenyl-arsonic acid is utilised to precipitate the titanium. This scheme enables silica, calcium, magnesium, manganese, iron, aluminium, titanium, and zirconium to be determined on one sample. The powdered mineral is fused with twenty times its weight of potassium persulphate at dark red heat in a platinum dish, the fusion process being carried on for one to two hours. The melt is then dissolved in dilute sulphuric acid, and filtered. In the precipitate, silica is estimated either by removal with hydrofluoric acid, or by fusion with sodium carbonate-borax, and solution in hydrochloric acid. Any liquid from this operation is returned to the main solution. This solution is oxidised

with potassium chlorate, and made up to a known volume (solution A). An aliquot portion of this is given a double precipitation with ammonia, and the precipitated hydroxides filtered off. From the filtrate, calcium is precipitated as oxalate, which is estimated by a permanganate titration. Magnesium is then precipitated by 8-hydroxyquinoline, converted to the oxide by ashing, and weighed. Since manganese may also be precipitated here, it is subsequently converted to permanganate, and estimated by titration. The hydroxides which were precipitated from this portion of solution A are dissolved

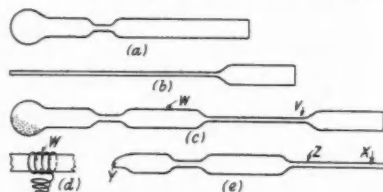


Fig. 2.

in 1:1 hydrochloric acid, and the solution diluted somewhat. A large excess of the sodium salt of *p*-hydroxy-phenyl-arsonic acid (2-4 g. for 20-100 mgm. TiO_2) is added in the presence of ammonium thiocyanate (not more than 1 g. for each 70 mgm. TiO_2). As precipitate, titanium and zirconium are both obtained, ashed, and weighed as oxides. The filtrate from this precipitation is made ammoniacal, acetate added, and then 8-hydroxyquinoline, thus bringing down iron and aluminium. These are ashed and weighed as the oxides, which are subsequently fused with pyrosulphate and redissolved. The iron may then be titrated or the aluminium precipitated, using ammonia and thioglycolic acid. In order to distinguish between zirconium and titanium, a second aliquot of solution A is precipitated with potassium hydroxide, and the titanium estimated through an iron titration. It is then possible to calculate the zirconium by difference.

The micro estimation of water in minerals has been the subject of an investigation¹⁰ which has permitted the development of a method suitable for application to a few milligrammes. The procedure is based on the earlier work of Brush,¹¹ Penfield¹² and Almström,¹³ the last-named of whom had succeeded in

reducing the scale of the earlier methods to enable it to deal with 20-60 milligramme samples. A tube (6 mm. diameter) shaped as shown (Fig. 2a) is dried for several hours at $110^{\circ}\text{C}.$, wiped clean with moist flannel, and weighed after 10 minutes acclimatisation in the balance case. A good analytical balance may be employed for this purpose, using semi-micro technique. A drawn-out tube (Fig. 2b) is inserted, and the finely ground mineral added through this so that all of it goes into the bulb of the weighed tube. A second weighing gives the weight of the mineral. The tube containing the mineral is then held at 45° to the horizontal, and drawn out as in Fig. 2c; it is then cut at the point *v*. When cool, a micro condenser is fitted at the point *w*, either by wrapping a moistened strip of filter paper round the tube, or preferably by affixing a spiral of copper wire ending in a little spiral basket (Fig. 2d) which is used to hold a small piece of solid carbon dioxide (dry ice). The bulb is first heated with a small bunsen flame, and finally with a small blow-pipe flame, so that it fuses completely, enclosing the sample. The whole process of heating should not take more than five minutes. The fused bulb is drawn off by means of a glass rod, leaving the tube as shown in Fig. 2e. The condenser is removed, and the tube allowed to come to room temperature (5 minutes), after which the open end is sealed at *x*, and the water centrifuged to *y*. The outside of the tube is wiped with a moist flannel, the neck cut at *z*, and a weighing of the opened tube carried out immediately. The tube is then placed, mouth downwards, in a centrifuge tube which has a pad at the bottom to catch the water. Centrifuging removes the water completely, and a second weighing gives the amount of the water by difference. If it is required to test the water (as, for example, by indicators; or for freezing point or boiling point) the major portion of the specimen may be removed by a capillary pipette before the final centrifugation. It is of note that the centrifuge method of removing the water is so efficient that subsequent thorough drying of the tube at 110° does not alter its weight. On a mineral which was expected to give a figure of 20.00 per cent., three samples weighing 0.95, 0.46 and 12.71 mgm. gave respectively 21.0, 20.6 and 21.1 per cent. water, or a mean of

20.9 per cent., when a solid carbon dioxide condenser was used. With wet filter paper the results, as one might expect, were slightly lower—19.1 per cent. and 18.6 per cent. on 0.5 mgm. samples.

Reagents

Fluorescence indicators.—Morin, well known as a sensitive qualitative reagent for aluminium,¹⁴ has been recommended as a fluorescence indicator for acid-alkali titrations.¹⁵ The indicator is used as a 0.2 per cent. solution in 50 per cent. alcohol, which is yellow, and which shows a yellow-green fluorescence in filtered ultra-violet light. When an alkali containing the indicator is titrated in filtered ultra-violet light, the pale yellow-green fluorescence of the solution becomes fainter rapidly as the end point is approached. As the end point is passed the colour alters to bright emerald green. If the titration is carried out in the reverse direction, the solution is colourless at first. When the required amount of alkali is added, the solution shows pale emerald green, further addition of alkali altering this to a bright greenish yellow. Several other compounds have been proposed as fluorescence indicators.¹⁶ The aqueous solution of *o*-methoxy-benzaldehyde is pale yellow, and in filtered ultra-violet light it fluoresces bright green. This bright green, which persists in alkaline solution, disappears in acid solution. In alcohol, the orange-yellow solution of *o*-phenylene-diamine hydrochloride also fluoresces orange-yellow, whether added to neutral or alkaline solutions. But the acid solution does not fluoresce. The deep orange neutral solution of *p*-phenylenediamine fluoresces dark red. In acid solution this fluorescence alters to bright green, whereas the alkaline solution shows no fluorescence.

Sodium thiosulphate.—The method of standardisation of sodium thiosulphate solutions has been investigated.¹⁷ It has been shown that when this involves titration against the iodine liberated in acid dichromate, particularly where the temperature range is as high as 23° - $40^{\circ}\text{C}.$, a considerable error is due to loss of iodine by volatilisation. To avoid this as far as possible, the concentration of potassium iodide at the beginning of the titration is increased somewhat, and the acid is added to the dichromate solution after addition of the potassium iodide, in preference to adding the potassium

iodide to the already acidified dichromate. In order to permit the liberation of iodine to be complete, an interval of 5-6 minutes is usually allowed before the thiosulphate titration. As an added precaution, washing water is so manipulated that a layer of almost pure water lies over the dichromate-potassium iodide-iodine solution during this period of waiting. Alternatively, this time of waiting may be cut down by using copper ions to catalyse the iodine liberation.¹⁸ Five mls. of N/1000 copper sulphate are sufficient for the catalysis, while the mineral acid usually employed is replaced by acetic acid. The titration is then carried out between 20-25° C. The accuracy of this latter method is apparently very high.

Experiments have shown¹⁷ that chloroform or mercuric chloride may be used as preservatives for standard thiosulphate solutions, but at higher temperatures (40° C.) these are effective only up to two months. It is remarked, however, that both sodium hydroxide and sodium carbonate accelerate the breakdown of sodium thiosulphate at this temperature, rather than retarding it.

Volatile reagents.—The evaporation of standard solutions from the tips of micro burettes, a possible source of error, has been investigated, and the results show¹⁹ that the loss is not serious, even over appreciably long periods of time, unless the solute itself is volatile, as in the case of iodine or hydrochloric acid. In such a solution, the contents of the tip should first be rejected before proceeding with the titration. The amount of trouble to be experienced in this way varies from case to case. For example, even 0.1 molar iodine solutions are subject to a marked loss: but on the other hand, 0.5 molar hydrochloric acid solutions do not alter seriously.

Sulphur

Elementary sulphur can be estimated turbidimetrically by making use of the action of ammoniacal copper sulphate solution in the presence of hydroxylamine hydrochloride.²⁰ The sulphur is first extracted by acetone, direct sunlight being avoided as far as possible. It seems that in organic solutions, sulphur may react photochemically to form a product which is unaffected by the reagent here advocated. The solution of sulphur, however, combines with the reagent to

produce colloidal cuprous sulphide. The turbidity formed in this way is preferably estimated photoelectrically, and the amount of sulphur (of the order of one microgramme in 10 mls.) is then obtained from a previously prepared calibration curve. While sulphur in organic compounds is easily determined by combustion to sulphuric acid, which is then estimated by titration against standard alkali, this method usually gives erroneous results when nitrogen or halogen is present, due to the difficulty of removing the acids corresponding to these elements. It has been found²¹ that if a stream of air which has been thoroughly washed to remove all traces of ammonia is passed across the mixed acids on a steam bath, the interfering acids are completely removed in forty-five minutes, while the sulphuric acid remains behind in entirety, and may be titrated after cooling. This procedure works satisfactorily in the presence of even large amounts of nitrogen, chlorine, bromine or iodine; but it is not applicable to metallo-organic compounds, since in them the sulphur is not totally converted to sulphuric acid during the combustion.

It is well known that various methods of precipitation of barium sulphate will affect the gravimetric estimation of the sulphate ion to a great extent. In order to combat these variations, an involved precipitation procedure, which is claimed to give an accurate and true result, has been worked out.²² In the first place, all metallic ions other than sodium must be removed. The neutral solution is then treated with 20 mls. of 10 per cent. sodium chloride and 5 mls. of 10 per cent. hydrochloric acid. The solution is made up to 100 mls., and divided into two portions of 47 mls. and 53 mls. The first portion is diluted with 100 mls. of water, brought to boiling point, and 11 mls. of precipitating barium chloride solution are added in six approximately equal portions at 5-second intervals. After three minutes, a further 7 mls. are added in the same way. Next, 24 mls. of the hot barium chloride solution are added in a steady stream, and to this whole solution the hot second portion of the sulphate solution (53 mls., which has been diluted with water to 90 mls.) is added in four or five portions at 5-second intervals. The precipitated solution is kept hot for half an hour, and filtered after 24 hours. In order to avoid sticking of the precipitate

to the walls of the vessel, and creeping, both of which give trouble if the last traces of the precipitate are washed into the filter with water or with solution low in salt content, the filtrate is returned to the beaker for this purpose.

Two volumetric methods for the estimation of sulphate have been proposed. One²³ claims to avoid the difficulties inherent in the ordinary use of tetrahydroxyquinone as indicator, by using it externally. In the first place, interfering substances such as hydrogen and aluminium ions, and sodium chloride, must be removed. Then, spotting the indicator on filter paper, the first immediate change from yellow to pink, as observed by transmitted light, is taken as the end point. This end point may be confirmed spectrophotometrically. It is found that at 5250 A.U. there is a sharp drop in transmittance of the indicator solution on adding a little of the titration solution after the end point has been reached. This decrease is not shown, however, if the end point has not been attained.

The other volumetric method²⁴ makes use of the fact that di-sodium hydrogen phosphate, which is itself alkaline, gives an insoluble precipitate with barium in neutral solutions. Because of this, barium solutions may be titrated against di-sodium hydrogen phosphate with methyl red as the indicator. The sulphate determination utilises this titration. To a sulphate solution, excess of barium chloride solution is added. The resulting mixture is neutralised to methyl red, and titrated with phosphate solution, thus determining the amount of barium chloride in excess. If a little alcohol is added in this last titration, it renders the estimation more correct, since the barium hydrogen phosphate is less soluble in alcoholic solutions. It is pointed out that di-ammonium phosphate cannot replace the di-sodium phosphate, since the barium phosphate is soluble in solutions containing ammonium ion. But under the conditions described, the estimation of sulphate requires only ten to fifteen minutes, and gives results accurate to ± 0.5 per cent.

A new principle has also been employed to estimate anions such as sulphate and chloride,²⁵ by employment of artificial resin base exchange. Using a suitable resin, the cation or cations in solution are replaced by hydrogen ions, and the free acid is subsequently esti-

mated by titration against N/100 sodium hydroxide. By this procedure, a specimen containing 36.81 per cent. sulphate was found to give values of 36.78, 36.80, 36.71, 36.74 and 36.73 per cent., while a chloride for which the calculated figure was 47.56 gave the values 47.58, 47.60 and 47.62. It is obvious, of course, that this method does not differentiate between anions, since it is directly dependent only on a hydrogen ion estimation.

Selenium and Tellurium

When an acid solution prepared from copper containing either or both of these elements is treated with sodium hypophosphite, selenium gives a red precipitate, while tellurium gives a black precipitate.²⁶ Since the reaction is sensitive, it affords a good qualitative test for these elements, while the fact that the precipitation is quantitative permits estimation of the elements. The precipitate is filtered off, washed with 50 per cent. hydrochloric acid, dissolved in hydrobromic acid-bromine and reprecipitated. The redissolved precipitate is then diluted with 50 per cent. hydrochloric acid, and the selenium only is precipitated by saturation in the cold with sulphur dioxide. This precipitate is washed with hydrochloric acid and alcohol, then dried and weighed. The tellurium is precipitated from the filtrate, which has had ammonia and hydrazine hydrochloride added, by passage of sulphur dioxide and boiling. Selenium in copper has also been precipitated by potassium hypophosphite in the presence of urea.²⁷ Since tellurium is co-precipitated, the whole is washed with boiling 5 per cent. aqueous potassium cyanide solution. This dissolves up the selenium, but not the tellurium. After filtration, gum arabic is added to the filtrate, which is then aerated for 15 minutes, and titrated with potassium iodate, using carbon tetrachloride as indicator.

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(Continued at foot of p. 10)

LETTER TO THE EDITOR

Science and Technology

SIR,—I am glad you take an interest in the discussion on the position of science and that your position comes so near to that which I am myself anxious to defend. I agree with your demand for the statement of specific tasks to be undertaken in the systematic extension of applied research and your insistence that each of these tasks should be advocated clearly on its merits rather than made part of a confused campaign for the revaluation of science. The various points you make in this connection seem very useful indeed (see *THE CHEMICAL AGE*, December 19, 1942, p. 545).

I differ from you, however, where you seem to deprecate the distinction between pure science and technology. I believe in the usefulness of the distinction because the two types of research have to be cultivated on somewhat different grounds. The aim of extending our understanding of the Universe regardless of the practical use of the results must be clearly maintained if science is to prosper. I can see therein no debasement of the pursuit of technology the purpose of which points in a somewhat different direction. While there is a good deal of overlapping and mutual stimulus between research undertaken for purely theoretical and for clearly practical aims the two kinds of investigations must on the whole be conducted by different institutions and also in a different spirit. I would deprecate the tendency in members of a research school attached to a Chair of Pure Science (physics, mathematics, chemistry, zoology, etc.) at a university if instead of pursuing the fundamental interests of their subject they would be mainly concerned with practical inventions and the improvement of technical processes somehow connected with it—but I would equally deprecate it if I found the staff of an industrial research laboratory uninterested in the immediate problems of their own industry and of their own factory, while hankering after the pursuit of general problems which are only distantly connected with their branch of technology.

The tendency so emphatically pursued by the Association of Scientific Workers and the movement for which they stand, of denying the distinction between pure science and technology, is clearly a threat to science because it makes technology the senior partner in the union of the two and places pure science into a wrong position. It emphasises out of proportion the practical value of science and thus distorts its true conception. It urges as a principal policy the application of a technique of systematic planning which is suitable to certain applied problems and also to a certain number of routine tasks in pure science, but which is utterly destructive to all original work, and particularly so in pure science. Science

cannot thrive if its cultivation is advocated for wrong reasons, and by a technique which is hostile to its very essence. Science must decay if the values of scientific truth, the motive for their pursuit and the proper way of cultivating them are admitted only on sufferance; as a concession—as it were—to a few exceptional people who persist in remaining incorrigible individualists. Such an approach to science represents an utter denial of scientific culture.—Yours faithfully,

M. POLANYI.

Department of Chemistry,
University of Manchester,
December 29, 1942.

A CHEMIST'S BOOKSHELF

BIBLIOGRAPHY OF THE LITERATURE RELATING TO CONSTITUTIONAL DIAGRAMMS OF ALLOYS. By J. L. Haughton, D.Sc. (Institute of Metals Monograph and Report Series, No. 2). London: The Institute of Metals. Pp. 163. 3s. 6d.

This bibliography contains over 5000 references to papers dealing with the constitution of binary, ternary, and higher alloy systems, both ferrous and non-ferrous. References have been included not only to papers of a purely constitutional character, but also to many X-ray and physical-property studies of alloys, which have some bearing on the constitution. To furnish some guide amongst the references (which in a few systems exceed 100), asterisks have been placed against those in the originals of which a new equilibrium diagram, or portion of one, is to be found. It is intended that the bibliography shall be used in conjunction with the abstracts that the Institute has published since its foundation, first in the *Journal* and then in *Metallurgical Abstracts* (Series II); for convenience, therefore, references have been included to these abstracts, whenever such exist. The bibliography is thoroughly up to date and contains references to all papers seen up to the time of going to press. It should prove invaluable to all those interested in the constitution of metallic alloys.

(Continued from p. 9)

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Metallurgical Section

January 2, 1943

Reclaiming Zinc and Lead The Treatment of Complex Residues

by A. G. AREND

THE reclamation of zinc and lead from complex residues has involved research work extending over several generations, since formerly much of this class of material was allowed to accumulate on waste dumps in mining districts all over the world. A feature of importance to note is the comparatively low market value of these metals, which, when only a small percentage obtains, often makes their recovery an uneconomic proposition to tackle. Quite a fair number of concerns engaged on this reclamation work had eventually to abandon their process, not because of any failure of a technical nature, but because the costs, which it had been hoped with experience to be able to reduce, had remained at their initial high figure. On the other hand, the installation of highly mechanical outfits capable of operating the process without the need for much labour, although ensuring lower working costs, meant that the initial outlay was correspondingly increased. This latter feature would not have been so important had there been an assurance that the waste materials would continue to abound in the same district, but as a rule the material came from widely separated districts. It is this state of affairs which accounts for the periodical appearance of offers by metal brokers for large consignments of zinc-lead residues which are available, but for which, at least in peace time, there were comparatively few buyers.

One of the secrets of success is to secure the means of acquiring a reasonably regular supply of ordinary zinc residues, from smelters engaged on the distillation of zinc, and then periodically to acquire large shipments of the complex residues from abroad. In this way, the process is kept going, and although the treatment of the richer and purer

by-product from the retorts of the distillation process does not yield much profit, this is more than compensated for when the waste material comes to hand.

As the demand for zinc has increased recently to meet the needs of aircraft alloys, efforts have been made to revive reclamation processes, and seek out existing waste sources.

Residue Sources

One of the familiar zinc residue sources is that which obtains when batteries of zinc distillation retorts have to be taken down for repair or rebuilding. The side walls are first removed, when lines of retorts lying in horizontal position are to be seen disconnected from their accompanying receivers. A considerable proportion of the by-product is contaminated with the remains of brickwork, rubble, etc., while the material scraped out from the individual retorts contains all the matter which has not lent itself to ready volatilisation. This includes metals such as iron, manganese, lead, copper, and minute proportions of bismuth and silver, not to mention associated silica and alumina, etc.

During the last war certain zinc distillers did not trouble to treat this material, as the prospect of making it pay was not inviting, particularly as much untreated fume and flue-dust also abounded on the premises. The large number of horizontally placed retorts makes it necessary to scrape each unit out separately, and then collect the heaped-up mass which has accumulated against the side-walls, whereby it is almost impossible to prevent brick waste, and mortar, from being included.

As distinct from this, residues of the more complicated lead-zinc order come to hand from mining camps in large shipments, almost always in bulk, which obviates preliminary collecting work;

but whereas the former purer material is of fine disposition, the complex residues are usually supplied in hard lumps which necessitate preliminary grinding. It is well to keep a stock of the purer by-product zinc waste always on hand, and to incorporate a proportion of this with the complex residues in the charges.

Sulphur Sources

Furthermore, a proportion of zinc blende is always desirable, since so much copper and iron are present which require attention that a source of sulphur is needed without impoverishing the charge. If roasting to remove sulphur were to be persevered, with, without any means of forming fixed compounds, particularly when the total sulphur in the charge is relatively small, this would only lead to practical complications, and in actual practice it is considered better policy to work on predetermined ratios. Regarding the source of sulphur, the high atomic weight of lead rules it out, although otherwise suitable, since galena contains some 13 per cent. of sulphur compared with nearly 33 per cent. provided by blende. In order to make a good roasting separation, the evolution of sulphur must proceed uniformly.

The preliminary roasting is carried out on a cylindrically-shaped roasting hearth, although several of the seven hearths usually provided can be dispensed with. The former water-cooled, or air-cooled, revolving arms have been to-day supplanted by arms and rakes made of chrome steel which remain rigid throughout the heating, and obviate the necessity of making frequent replacements. Ports are located at convenient points in the side-walls so that air may be admitted, and increased and diminished in volume as required. Without this provision, the accurate type of roasting involved could not be properly performed, and instead of the earlier style of simply shifting the position of a brick in the wall, calibrated flaps are substituted nowadays. The air-flow is tested with an anemometer and Pitot tube, while recording devices have recently been introduced. As the shaft, which operates the arms with the rakes, is supported on a step bearing, using reducing gears, it is possible to vary the speed of revolution to from 1 to 4 revolu-

tions per minute. A producer situated outside provides gas for the firing.

The charge is fed by a special apron-feeder which takes the form of a square-sectioned truncated cone, and delivers the mass in an exceedingly fine, uniform stream on to the top hearth, with the assistance of a small belt conveyor. The rakes cause the mass to pass to the outer edge of the hearth, in the first instance, and then drop to the second hearth, where it is raked back to the circumference. Recent research has revealed that in the case of complex residues containing numerous different metals, as in the case of zinc-lead residues, the desired condition whereby the mass will lend itself to easy subsequent wet treatment will not readily be reached unless the mass receives an intermediate cooling. This adds materially to the fuel costs, as the cooled mass has again to be heated up and the roasting continued, but so far from slowing down the process, it often actually speeds it up to a considerable extent. The reason for this is that the fine particles get the opportunity to be properly aerated, whereas, within the precincts of the hearth, the furnace gases are polluted with carbon dioxide, carbon monoxide, etc.

Intermediate Cooling Device

The intermediate medium used consists of a conically-shaped hopper device made of steel sheets bolted together and lined with firebrick, from which the hot mass emerges on to a revolving table below, and thence to the bottom floors of the hearth. This idea originated from experiments which were carried out on a small scale, when it was ascertained that repeated heating made the expulsion of sulphur in the desired manner much more flexible, but which at first was considered too complicated to operate successfully on a large scale, as this might involve the erection of much plant. Provided that this intermediate cooling is performed at a fixed degree, and the roasting then proceeded with, the most exacting treatment can be successfully carried out. Each stage of the roasting has to be followed with precision, and rapid chemical tests are made to see that the respective metals have reached the desired condition.

Not only is it possible to acquire the zinc in the necessary sulphate condition, immediately soluble in water, but the

copper, and any little nickel which may be present, are maintained insoluble as the oxides.

A review of the specific temperatures required for acquiring this desirable condition will reveal what a small margin for error is permissible, and will give some indication of the trouble which was taken to perfect the roasting conditions. At 739°C . what zinc blende has been converted to the sulphate condition can be altered to the oxide ZnO , while at 704°C ., copper sulphate is converted to the insoluble oxide CuO , and at 708°C ., nickel sulphate is converted to the insoluble oxide NiO .

Exactng Type of Roasting

This means that the margin is an exceedingly small one, since the range lies between 708° and 739°C . Between these degrees the mass obtained can be digested in ordinary hot water so as subsequently to dissolve out the bulk of the zinc, a thing which was otherwise not possible without the addition of at least a little sulphuric acid. (Although theoretically sulphates obtained by roasting are supposed to be soluble in water, in practice it is generally necessary to add a few points per cent. of acid, to draw them successfully into solution). The addition of acid to the foregoing complex residues would thereby immediately become polluted with copper, and nickel. There is no interference from manganese, as the sulphate of this metal is converted to the oxide Mn_2O_3 , at 680°C ., while iron is rendered insoluble at 530°C .

The hot mass is directly charged from the final floor of the roaster into capacious tanks, where hot water is continuously pumped over it. This is done by having the tanks constructed with a false bottom, usually of perforated oak, and the pump also acts in the capacity of a suction device to the mass itself, and rapidly draws out the liquors and redelivers them in hot condition to the exposed surface. After a fixed period of this treatment, despite the fact that the zinc sulphate has been wholly obtained by roasting, it is almost entirely washed out, without any trace of copper or nickel.

The perforated false bottom, in large tanks, is about 3 feet from the floor level, and serves the purpose of allowing the washed mass to be immediately ejected

to a line of skips which are run up on rails outside. These skips are mounted on swivels, so that the wet mass can be directly dumped into cylindrical stir-tanks for extraction of the copper, and



Zinc retorts, from which residues are recovered, in process of demolition.

any nickel present, using a solution of 1 to 2 per cent. sulphuric acid.

The extracted zinc sulphate solution is transferred to electrolytic tanks for deposition of the zinc. The insoluble material from the extraction of the copper contains, besides oxides of iron and manganese, and the silica and alumina from the brickwork, etc., all lead in the form of lead sulphate. In the roasting treatment, lead sulphate remains intact up to a white-heat, and is readily treated for extraction of the bismuth during subsequent refining.

When this process for reclaiming metal values from complex residues was first introduced, the very accurate method of controlling and manipulating the roasting conditions raised the hope that it might even be possible to separate copper and nickel by adaptations of the system. In practice, however, it transpired that the one metal appeared to react with the other, and any satisfactory separation was thus precluded; the process accordingly is retained for complex zinc and lead residues only.

Soft Silver Solder

Substitute for High-Tin Material

A MODIFIED silver-lead solder, containing only a small percentage of tin, and marketed under the name of Comsol, originally developed for soldering the armature end windings of electric motors to their commutator segments, has now, owing to its special properties, been developed as an effective substitute for high-tin solders. It may be used for bit or blowpipe soldering on tin-plate, copper, and copper alloys, and it has been extensively used for dip-soldering, radiator assemblies, and similar parts. For bit-soldering it may be used with either zinc chloride, zinc-ammonium chloride, or resin as a flux. For electrical purposes and similar applications where a non-corrosive flux is essential, the use of resin is recommended; at the higher temperatures of soldering this flux, it is stated, is appreciably more active than when used with the ordinary tinman's solder, and no difficulties are experienced in producing uniformly sound joints. For blowpipe soldering, when there may be a tendency to overheat the work locally, zinc chloride fluxes are recommended; resin is liable to be charred under these conditions.

The makers, Messrs. Johnson Matthey & Co., Ltd., 73/83 Hatton Garden, E.C.1, give the following properties:

Melting-point, 296°C . (no appreciable plastic range).

Maximum tensile strength (measured on a specimen strained at 0.45 in. per inch of gauge length per minute), 2.5 tons/sq. in.

Elongation (measured on a gauge length of $4\sqrt{A}$ strained at the above rate) 44 per cent.

Density, 11 g./c.c.

Vickers pyramid hardness, 13.

This solder, it is stated, flows very readily and produces sound strong joints in copper and tinned iron. The strength of butt joints approximates to the strength of the solder in cast condition. Preliminary creep tests carried out in the firm's laboratories have given the following results: at 150°C . tinman's solder fails in about 10 hr. under a stress of 100 lb./sq. in., whereas Comsol stands up to this load practically indefinitely. Comsol withstood 500 sq. in. for about 250 hrs. at 150°C . and 250 lb./sq. in. for about one year.

The amount of copper dissolved by Comsol in 18 hrs. at 400°C . is stated to be no more than is dissolved in 20 mins. by pure tin at the same temperature. This, it is pointed out, is an advantage when using the solder as a dipping bath.

Comsol is available in rods of $\frac{1}{8}$ in. and $\frac{1}{4}$ in. diameter or in ingot form. The cost is stated to be comparable with that of high-grade tin-lead solders.

Non-Ferrous Scrap Metal

Merchants' Association First Meeting

THE first annual general meeting of the National Association of Non-Ferrous Scrap Metal Merchants was held in London on December 16. The chair was occupied by the president, Mr. H. B. Barnard. Non-ferrous scrap metal merchants, he said, had never previously been associated on a national basis, although there were already in existence throughout the country, and also in London, several organisations doing most useful work in connection with non-ferrous scrap. They must, he said, convince those people outside the trade that, although they styled themselves non-ferrous scrap metal merchants, they did more than merely buy and sell; they collected the scrap, broke it down, graded it, and generally prepared it for re-use in the furnace, for eventual return to industry as pure non-ferrous metal. Local councils seemed to emulate that skilled performance, and while they in the trade must watch their (the councils') activities seriously, the best service they could do themselves was to do the job better than the councils could, which certainly was possible.

Committee Set Up

A joint scrap (non-ferrous) committee had been set up on a national basis to speak for virtually every trader in non-ferrous scrap who belonged to an association at all. Mr. Barnard gave the names of those constituting the committee as follows: representatives of their own Association; Mr. F. M. Garnham, Mr. Victor Brenner, and Mr. Platt; representatives of the National Waste Material Dealers' Federation; Mr. Arthur Austin, Mr. Reuben Barnett, and Mr. George Garnham; representatives of National Federation of Iron and Steel Merchants: Mr. W. Wood, Mr. Tom White, and Mr. Chalmers.

Election of Officers

At the first meeting of that committee, their own vice-president, Mr. F. M. Garnham, was unanimously elected chairman. It would be noticed that Mr. Garnham's son also served on that committee, and he (Mr. Barnard) was happy to place on record the valuable work which they, father and son, did for the trade. The result of the ballot for the presidency, vice-presidency, and membership of the council for the ensuing year was as follows:—president: Mr. F. M. Garnham (Purley, Surrey); vice-president: Mr. Victor Brenner (Birmingham); council: Mr. H. B. Barnard (London); Mr. A. M. Bowes (London); Mr. E. M. Gollance (London); Mr. A. H. Dandridge (London); Mr. C. R. Hague (Sheffield); Mr. H. E. Rose (Bristol).

South African Platinum*

Production in Recent Years

IN 1939, South Africa, with 40,034 oz., was the third largest producer of platinum in the world, and accounted for roughly 9 per cent. of the total output. Next came the United States with 37,796 oz., and other sources included Australia, the Belgian Congo, Colombia, and Abyssinia. In 1940 the United States output increased to about 44,300 oz. The United States is also an important refining centre; during 1940, 47,339 oz. of new platinum metals and 66,430 oz. of secondary platinum metals were recovered by American refineries.

South Africa is the world's chief producer of naturally occurring osmium-iridium alloys (osmiridium), the output of which amounted in 1939 to 6094 oz. Included in the osmiridium sold are osmium, iridium, ruthenium, rhodium, platinum, and gold. Though the first shipment of 23 oz. was not made till 1920, the presence of osmiridium and platinum in the auriferous conglomerates of the Witwatersrand (New Rietfontein) was established as far back as 1892. In 1922, the preliminary concentration in place of amalgamation was introduced on the Reef, and made practicable the recovery of platinum metals on a large scale.

Location of Main Deposits

The output is obtained chiefly from the Main Reef Leader on the East Rand, though the Kimberley Reef on the West Rand also yields appreciable quantities. The osmiridium is associated with the big pebbles, and its distribution corresponds closely with that of gold. The proportion by weight to conglomerate is extremely small even in the richest areas, where it ranges from 1 oz. per 1200 tons milled to 1 oz. per 2000 tons. It is thus economically recoverable only as a by-product and because it is amenable to cheap and simple treatment.

Effects of the 1930 Slump

The Union's resources of platinum ore are enormous. Production dates from 1926, when 4951 oz. of platinum metals were mined and sold. By 1930 production of platinum reached the peak of 55,000 oz. Then came a disastrous fall in price. In four years the value of platinum fell from nearly £19 per oz. to not much more than £6 per oz., the slump being due partly to increased production throughout the world and partly to the general industrial depression. South Africa found herself at a serious disadvantage when competing with

Canadian and Russian producers, owing to the relatively high costs of reducing the complex ores encountered in the Transvaal lode deposits. Gradually the various companies suspended operations until the only remaining producer was the Rustenburg Platinum Mines, Ltd., which is still the only operating platinum mining concern in the Union.

Gravity plus Flotation

At their Kroondal-Klipfontein mine a system of gravity concentration followed by flotation is adopted. By the gravity process clean metallic concentrate is obtained which goes directly for refining, and by flotation a concentrate is produced which consists of a platiniferous mixture of copper, nickel, and iron sulphides with some gangue. Flotation concentrates are smelted in a blast furnace, subsequently reduced by a converter, and shipped to Britain for further treatment and reduction. For a number of years the ore treated was chiefly oxidised ore with 10 to 15 per cent. of sulphide. Latterly, sulphidic ore has increasingly replaced the oxidised variety, and this has involved modification of the plant and process. In 1939 the plant was enlarged and altered to treat sulphide ore, its enlarged capacity being 25,000 tons per month.

Whereas production of platinum and osmiridium in crude and in concentrates amounted in 1933 to only 14,158 oz., it jumped the following year to 37,761 oz., and has since more than doubled. In 1940 production aggregated 76,318 oz. of crude platinum and 1175.171 tons of concentrates, the estimated contents of platinum metals amounting to 71,975 oz., as compared with 59,311 oz. in 1939. In the report of Rustenburg Platinum Mines, Ltd., for the year ending August 31, 1940, stocks of platinum metals on hand were valued at cost of production, £246,937, and were reported to have increased during the year.

No Local Ore-Treatment

Although the Union has the largest known platinum deposits in the world, the fact that the ores are sent overseas for final treatment seems to preclude the use of South African platinum by local consumers in place of imported metals. South African manufacturing jewellers have been seriously affected by the export restrictions now in force, since most of the better class of jewellery is made up from this metal. An alternative metal which might be used is 18-carat white gold, but this material, too, appears to be scarce.

* From an article in the *South African Mining and Engineering Journal*, October 31, 1942.

Formation of Hair-Line Cracks

Discussion on Recent Metallurgical Papers

AT a recent meeting of the Iron and Steel Institute, held in conjunction with the Sheffield Society of Engineers and Metallurgists, and the Sheffield Metallurgical Association, in Sheffield, various metallurgical papers were discussed. Referring to the contents of a paper on "The Methods of Determining the Solubility of Hydrogen," Dr. H. Lee, of China, said that the purpose was to investigate the way in which hydrogen was evolved from iron and steel specimens on cooling. A line for future experiments was suggested by Mr. H. H. Burton in connection with a paper on "The Formation of Hair-Line Cracks." The curves already obtained on the evolution of hydrogen after reheating had all been based on specimens which had been cooled completely to atmospheric temperature. It seemed very important to him that the experiment should be repeated on specimens which had been saturated with hydrogen and only cooled down to a temperature of about 300°C. before being reheated to, say, 650°C.

Mr. D. A. Oliver spoke of the interesting discovery of the spontaneous evolution of gas after a period called the incubation period. Another very important point which had been discovered was that if the specimen was cooled right down to room temperature, but prior to cracking, reheating at that stage did not subsequently prevent the specimen from cracking.

Formation of Hydrides

Dr. R. J. Sarjant said that to those who believed that hydrogen played a part in the formation of hair-line cracks, a clearer picture was obtainable from the experiments of Andrew and his colleagues of the mechanism of the changes in the steel giving rise to the formation of flakes. The authors postulated the formation of chemical compounds. The existence of compounds, possibly hydrides of chromium, manganese and nickel was suggested by Esser, Eilender and Bungeroth, and these might be regarded as being capable of breakdown and formation of internal pressure from the hydrogen liberated. Greater diffusion of the gas could be regarded as taking place at the higher temperatures, and the building up of pressure at the lower.

Dr. Hatfield said that there were a few real facts which must be conceded. First of all, he said, it was only a very small proportion of steel which suffered from hair-line cracks. The second point he made was in regard to the hydrogen content in commercial steels, which, he said, was very small. They had lately established that when the steel was liquid it did absorb quite

a lot of hydrogen. Falling down from the super-saturated temperature, however, the hydrogen was gradually evolved in the process of lowering to the simplifying range. When the steel solidified there was very little hydrogen there, and what little there was progressively departed from the steel in the sequence of hot working operations.

The Iron and Steel Institute papers under discussion were: 1, "The Formation of Hair-Line Cracks—Part I," by Professor J. H. Andrew, D.Sc., A. K. Bose, B.Met., G. A. Geach, M.Sc., Ph.D., and H. Lee, B.Eng., Ph.D.; 2, "The Formation of Hair-Line Cracks—Part II," by Professor Andrew, Mr. Bose, Dr. Lee, and A. G. Quarrell, Ph.D., F.Inst.P.; and 3, "The Determination of the Solubility of Hydrogen in Iron and Iron Alloys," by Professor Andrew, Dr. Lee, and Dr. Quarrell.

Tin Economies

Revised Soft Solder Standard

IN view of the fact that more economies in tin are essential, the British Standards Institution has just issued a further Memorandum (Memo No. 2) to B.S. 219 Soft Solders. Since the issue of the first memorandum experience has been gained in a variety of methods of saving tin used for solders and some new types of tin-economy solders have been introduced, but these recommendations should be considered as supplementary to and not as replacing those given in Memo No. 1. Where solder continues to be necessary, users are urged to carry out trials to ensure that, of the solders suitable for their purpose, the one necessitating the least consumption of tin is adopted in practice and three groups are given in order of tin economy generally effected: (1) lead base solders, (2) argent solders, and (3) solders specified in War Emergency B.S. 219. Copies of this Memorandum will be forwarded gratis to those requiring a copy who send a stamped addressed envelope to the British Standards Institution, 28 Victoria Street, S.W.1.

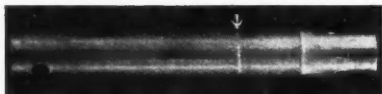
Chimboti, a Peruvian port, 200 miles north of Callao, is the site chosen for the blast furnaces and iron and steel works to be built under a contract signed between the Government of Peru and a U.S. firm. Situated amid the dry pampas the port is on the Pan-American Highway and is an outlet for important mining districts.

Detection of Cracks

Use of U.V. Light and Fluorescent Material

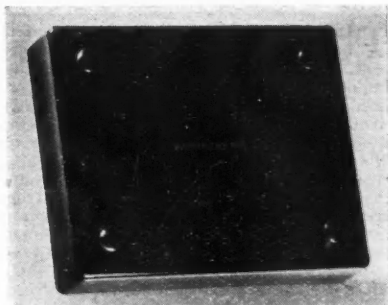
THE detection of flaws or cracks in ferrous and non-ferrous materials by the use of ultra-violet light and fluorescent materials offers, it is claimed, a new approach to the problem, according to a report published in *J. Sci. Instr.*, 19, 12, p. 189. A non-fluorescent material activated with ultra-violet light will appear black or purple, depending upon the nature of the material. A crack or flaw in the material, if filled with a fluorescent filler, will glow vividly with a characteristic colour; thus the flaw or crack is filled with light, while the remainder of the specimen remains dark. Typical examples are shown in the illustrations herewith.

The "Glo-Crack" system developed by Colloidal Research Laboratories, Ltd., 66/70 Petty France, S.W.1, makes use of this principle. The specimens, pressings, stampings,



Junction between two portions of screwed rod shown by U.V. light.

etc., to be examined are immersed for an automatically controlled period in a bath of fluorescent material at a temperature of 75°C. The specimens are withdrawn and then washed in a solution which removes all fluorescent material that has not become anchored to the edges of the flaws or cracks. Examination under a source of ultra-violet light immediately shows up any flaws or



Cracks shown as white lines; photographed by U.V. light.

cracks. Surface scratches which have a depth equal to or less than their width are not shown, it is stated. The total time taken to examine in this way a large specimen, such as a piston, does not exceed three minutes. The plant is available in either the single-batch or tray type, and the operation is entirely automatic.

The shape of the articles governs to some extent the technique employed; e.g., articles which can be loaded into trays and handled in batches can be best processed by dipping. Larger articles, such as airscrew blades, need a different technique. In general, the process can be adapted to deal with any articles, and has been successfully employed on specimens ranging from contact-breaker screws to aircraft petrol tanks.

HARD NICKEL PLATING

In a lecture on the Electrodeposition of Hard Nickel given by Dr. W. A. Wesley and Dr. E. I. Roehl, of the development and research division of The International Nickel Company, before the Electrochemical Society in Detroit, Mich., it was stated that nickel deposits of a hardness of 380 to 480 Vickers can be produced in thickness and quality suited to industrial and engineering applications by means of electrolytes containing ammonium salts. The authors showed experimentally that the soundness and structure of the deposit were markedly influenced by the composition of the plating bath in respect to other ingredients. Important improvements in the quality of the product could be accomplished by replacing the old hard bath by one composed of nickel sulphate, ammonium chloride, and boric acid. This electrolyte was well buffered and contained sufficient chloride to ensure high anode efficiency. The hardness of deposits

made from it varied but little with change in thickness and could be easily maintained by controlling the plating conditions.

AMERICAN STEEL RESEARCH

The Acid Open Hearth Research Association, formed at Pittsburgh towards the close of last year, with the purpose of conducting practical and technical research into the problems governing the production of steel in the acid open hearth steel furnaces, has now started operations. Mr. G. R. Fitterer, Department of Metallurgy, University of Pittsburgh, has been appointed director of research, and Mr. J. W. Linhart, research metallurgist. The work is being conducted under the auspices of the University of Pittsburgh with full study of actual furnace heats in the plants of the 19 member companies. The secretary of the new association is Mr. F. C. T. Daniels, 901 Bingham Street, Pittsburgh, Penna., U.S.A.

Phosphor Bronze Ingots*

Points to Remember and Defects to Avoid in Casting

THE casting for rolling purposes of bronze ingots varying from 2 to 8 per cent. tin and up to .35 per cent. phosphorus, required for the ultimate manufacture of thin strip, has always presented a greater number of practical problems in the casting shop than that of most other non-ferrous alloys. The bulk of this type of alloy is still produced in ingots of small dimensions cast into sloping cast iron ingot moulds from crucibles heated in coke, oil, or gas-fired furnaces. The bulletin covers in condensed form the main types of defect encountered in the production of this alloy and their effect on the finished article, and suggests methods of improvement.

Poor Surface Appearance

Inferior surface can be due to a variety of causes, but the appearance of the finished article is usually the same, that is to say, dirty, rough, defective patches, known as "spill" are found to cover much of the strip surface. The main causes can be classified thus:—

(a) *Slow Pouring Speed.* When the speed at which the molten metal enters the mould is slow, there is agitation of the zone of partially solidified alloy, resulting in folds and "cold shuts," waves, etc., on the ingot surface. Furthermore, any oxide, carbonaceous matter from the burnt dressing, or dirt not skimmed off before pouring, does not always remain on the top of the advancing ingot surface but becomes embedded in the partially solid area with a resultant hole in the ingot surface. Where the ingots are produced in inclined chill moulds, the pouring speed varies with the skill of the individual caster. Wherever possible vertical moulds should be used and the metal poured through holes of predetermined diameter located in the cast iron tundish or runner-box. When direct pouring methods are employed the use of vertical moulds facilitates the escape of gases, whereas with inclined moulds such gases tend to be entrapped as bubbles beneath the upper surface of the ingot.

It is important to note that while the pouring of the metal into a vertical mould requires, as already mentioned, the use of a tundish, there is an added advantage in that the metal can be distributed in a number of small streams across the width of the ingot. The momentum of a number of small streams is naturally not so great as that of a single heavy influx—the rate of pouring remaining the same—and the incoming

metal does not penetrate so deeply into the metal already in the mould. Bubbles are not carried down so far into the ingot and therefore have a better opportunity of escaping. The high temperatures involved, it is true, cause rapid erosion of the tundish and the holes quickly become enlarged. However, by coating the inside of the tundish with tar or a thin wash of a mixture of refractory material and water immediately after every cast, and while the tundish is still hot, its life may be prolonged for several weeks.

(b) *Tin Sweat.* A common defect met with, when the tin content of the alloy in use is on the high side, is the appearance on the ingot surface of a blue-grey "sheen." When the ingot is cold-rolled this layer proves to be much less malleable than the rest of the ingot and in consequence many fine surface cracks appear, usually at right angles to the direction of the rolling. Ultimately the surface of the strip produced becomes covered with a fine "spill" resulting from this surface disintegration. The cause of this trouble is the partial separation of tin from the alloy when slow cooling conditions prevail. The only way to prevent it is to use water-cooled copper-faced ingot moulds and to employ really accurate temperature control when pouring. Once this tin sweat appears, the only remedy is machining of the ingot surface and the complete removal of the entire area of defection.

(c) *Tin Segregation.* Some difficulty is often experienced due to tin segregation in the centre of the ingot. This can be minimised by introducing the tin into the melt with a master-alloy and by wrapping the phosphor copper in copper foil, forcing it well down into the molten charge, and then stirring it with a plumbago rod.

Effect of Inferior Dressings

(d) *Inferior Mould Dressings and Worn Ingot Moulds.* Unsuitable dressings may be too volatile and when applied to the mould surface tend to leave thereon dry patches immediately prior to pouring. This causes the molten metal to contact the bare walls of the moulds, resulting in the emanation of gases from the iron itself, leading to "blowing" and leaving ripples and folds on the ingot surface. Then again the dressing may burn too slowly, creating a surface defect similar to that caused by blowing. The dressing may vary in composition, contain moisture, or deposit a hard scale on the mould surface, which is difficult to remove as well as prejudicial to the success of subsequent casts.

The moulds used, through alternate and rapid heating and cooling, develop horizon-

* From "The Casting of Phosphor Bronze Strip Ingots"; Bulletin No. 1 of the General Metal Utilisation Co., Ltd., 55 Bishopsgate, London, E.C.1.

tal cracks across the faces which contact the molten metal. Moisture and excess dressing fluids find refuge in such cracks and tend to cause blowing, especially if the dressing is applied soon after the cooling operation and the moulds have had insufficient time to "steam out." One way of slowing down this appearance of cracks is to cool down the moulds by spraying with water while they are turned with the contact faces downwards, the exterior of the mould meeting the shock of the cold water and thereby avoiding the development of sharp temperature gradients.

The roots of the problem lie deep, however, in the fact that instead of accepting some ideal standard dressing—one universal preparation evolved by experts in the full light of metallurgical experience—this vital section of the industry is at the mercy of the sundry concoctions and mixtures that are in use. These home-made dressings are often the products of individual casters, alive or dead, and have remained in use because they have worked reasonably well in the past. Unfortunately, however, the resources of modern metallurgical research have played no part in their creation.

Causes of Internal Unsoundness

Internal unsoundness in the form of laminations and porosity comes from several causes and results in failure and rejection particularly of small parts for use in the electrical industry.

(a) *Lamination*, or the presence of distinct layers in the finished strip, may be due to piping caused by insufficient feeding at the top or "gate" end of the strip. It may also be due to shrinkage cavities lower down in the interior of the ingot caused by the inability of this part of the cast to be fed when contraction takes place during cooling if the speed of pouring is excessively high. High pouring speeds result in good surfaces but tend to produce internal unsoundness through shrinkage. Unless casting temperature and pouring speed can be accurately controlled, it is often difficult to strike the happy medium and obtain both good ingot surface and internal soundness.

(b) *Porosity*, that is to say, the presence of small holes throughout the mass of the ingot or in some well defined area may be due to the following causes:—

(i) *Entrapped Air* may be present owing to too low a casting temperature, with the result that air pockets formed at the point of contact of the molten stream with the partially cast ingot are injected some little way into the ingot and there trapped by premature solidification. It is emphasised that the bulk of the troubles experienced in casting arise out of low pouring temperatures and therefore it is always better, where error is inevitable, to err on the high side.

(ii) *Dissolved Gases*. If the products of

combustion of the heating medium used are allowed to contact the molten metal while the charge is nearing pouring temperature, a certain amount of gas may be absorbed by the molten metal. This absorption decreases with the temperature of the solidifying ingot, the tendency being for the gases to be trapped and thereafter remain as fine pin holes throughout the mass. Care should be taken to keep the charge covered with a protective layer of stick charcoal or other agent until the last possible moment before pouring.

The Ideal Mould Dressing

(iii) *Poor Dressing Materials*. During the latter part of the solidifying period, gases may be evolved which do not rise completely to the surface of the ingot. This results in the formation of a "gate" or "discard head" of undue porosity and depth, and in consequence an abnormal amount of metal has to be cropped from the top of the casting before rolling. The ideal mould dressing is one which would volatilise at a rate proportionate to the rise of the metal level in the mould, leaving sufficient solid matter behind to protect the mould surface. At the same time the volatile constituent should provide enough flame to exclude air from the mould during pouring operations.

Conclusions

The maximum internal and external soundness of phosphor bronze ingots should therefore be obtained by attention to the following points:

(a) Pouring speed to be as high as possible without causing shrinkage cavities.

(b) Pouring temperature to be as near as possible to the high limit of the range, especially when several ingots are cast from one melt.

(c) Cooling and solidification to be as rapid as possible so as to preclude the formation of tin sweat, $\alpha + \gamma$ eutectoid, and impurity segregation.

(d) Mould surfaces, if damaged, can be instrumental in causing defects; to lengthen their life, apart from taking special cooling precautions, a light machining of the casting faces when they begin to age will help to remove surface irregularities and present a new working surface.

(e) The use of a scientifically prepared mould dressing, and one adapted to the particular alloy being cast, is important. Inferior or unsuitable oils mixed with charcoal, french chalk, china clay, etc., in varying proportions cannot be expected to give perfect results in casting. The life of the mould is affected by the use of poor dressings, particularly when alloys of high melting point are being cast, direct contact of the molten metal with the face of the mould being harmful to both.

Metallurgy in Eire

Expedients to Conquer Metal Shortage

PRODUCTION of electrolytic iron on a large scale in Ireland, with specially adapted plant and equipment, was mentioned by Mr. de Valera in a recent speech advocating a supplementary vote of £5000 to assist the Emergency Scientific Research Bureau. Other possibilities touched upon in the speech included the use of high temperature carbonised hard turf charcoal for smelting iron; the relief of steel shortage by re-manufacturing steel scrap; manufacture of electrodes for calcium carbide works; and repair and manufacture of lead batteries.

Other ingenious expedients to overcome shortage of metal for spare parts were mentioned by Mr. Leslie A. Luke, Public Relations Officer, Dublin United Transport Co., Ltd., at a meeting of the Scientific and Engineering Association of Ireland, held in Dublin. Scrap metal was used as far as possible for small parts and repairs. Cylinder sleeves had been made from centrifugally cast iron water pipes; considerable progress had been made with producer gas equipment, but, as found elsewhere, the diesel engine was unsuitable for conversion.

North African Minerals

Vital Materials for Britain and U.S.

RAW materials available to the Allies in French North Africa, including supplies of zinc, lead, cobalt, and manganese, have been allocated to the United States and Britain, the Combined Raw Materials Board announced this week in Washington, according to Reuter.

The allocation is made with the co-operation of the French authorities in North Africa. After meeting local needs, supplies will go to the two countries on the following basis: to Britain, iron ore and pyrites, phosphate rock and superphosphates, zinc ore, and lead concentrates and ore; to the United States, manganese, cobalt ore and cork.

French North Africa ranks second only to the United States in the production of phosphate rock, with an average annual pre-war production of more than 4,000,000 tons. The average production of high-grade iron ores with more than 50 per cent. iron content is more than 3,000,000 tons a year. Exports in 1943 are expected to be considerably less than the demand.

DR. D. A. POWELL, the originator of the scheme for mass radiology which, it is expected, will be put into operation this year, has died in Cardiff at the age of 58.

Chinese Tin

Government Plan for Production

THE National Resources Commission, a Chinese Government agency, has taken control of the Chinese tin industry for the threefold purposes of increasing production, improving and standardising the quality, and promoting the market through a co-ordinated and unified system of production, transport, and selling. Smelter works erected in Kwangsi Province are responsible for the production of high-grade Chinese tin on substantial scale for the first time on record. The tin so produced, branded "P.K.M.A.," assays 99.87 per cent. minimum. China at present is suffering from a shortage of man power, hence the decrease in the production of tin in Yunnan Province; but given proper price stimulation and additional equipment China can reach her annual goal of 17,000 tons, and can even produce as much as 20,000 tons a year. Present transport difficulties may prevent efficient distribution of Chinese tin, but when the war ends, China's position in the tin industry may be very different from what it has been in the past.

Coal Sub-Committee

Operation, Man-Power and Welfare

AT the first meeting of the National Coal Board, which took place in London just before Christmas, Major Lloyd George said that while the general coal position was better than was hoped for six months ago, it was by no means as satisfactory as he could wish. If, however, producers and consumers made every effort, it should be possible to get through the winter. In view of the many questions with which the Board has to deal, it was decided to set up a number of Sub-Committees, as follows:—

1. The general planning of production, including the allocation of district and regional targets. The best means of securing the highest efficiency of the coal-mining industry and any improvements in machinery or methods of operation whereby output may be increased.

2. The provision of supplies, equipment and materials for the conduct of mining operations.

3. Matters relating to the maintenance of man-power and labour productivity, including the enrolment of new entrants and the instruction, training and advancement of boys and youths.

4. All matters affecting the welfare of mine-workers, including housing, transport and feeding facilities; and questions of health and safety and, in particular, such occupational diseases as silicosis and nystagmus, with a view to providing all possible preventive measure, clinical treatment and rehabilitation.

American Styrene Production

Progress of the Dow Chemical Company's Method

THE minds of American chemists are very largely occupied nowadays with the provision of substitutes for rubber, and the following authoritative account of the progress of styrene production is taken from an article in *Ind. Eng. Chem.* (1942, 34, 11, p. 1267) by Willard Dow, of the Dow Chemical Company, Midland, Michigan.

Styrene is contributing to the American synthetic elastomer programme as a basic material, and the general outline of how it will be utilised is well known. Many of the statistics on production schedules and quantities have been released for general publication. The story of the commercial development of styrene to the point that the process was ready when the large-scale need for it materialised has not been told. It is an interesting story and can furnish no aid or comfort to the enemy; furthermore, a lesson may thereby be learned as to other chemicals.

History of Styrene

The literature on styrene is voluminous. It extends back more than a century, both on the monomeric and polymeric substance. Experiments relating to several methods for making the monomer were reported prior to 1900. As early as 1928 some polymeric styrene of German origin was finding its way into the United States and was being experimented with as a moulding material. The properties of moulded specimens left no doubt of the desirability of the material as a plastic. Yet in 1931, when American research on styrene began, there were available only limited quantities of relatively impure monomeric styrene.

Styrene development in the United States is an example of the method of carrying on research by supplying chemists with plenty of so-called patient money while maintaining a prayerful attitude. In this respect, commercial development of styrene is really a tribute to the ingenuity and foresight of American chemists. It is distinctly the opposite of the development of so many chemicals which have had their origin in a stewpan on the kitchen stove tended by a non-technical individual with an avid curiosity. It may be added that our styrene development did not originate with a purchased German process.

Our first approach to the problem of making monomeric styrene involved a process leading through β -phenylethyl alcohol. Ethylbenzene was formed from benzene and ethyl chloride, and the ethylbenzene was then chlorinated to yield a mixture of α - and β -chloroethylbenzene. The β compound was

separated and hydrolysed to give β -phenylethyl alcohol, which was then dehydrated with an alkali to yield a relatively pure styrene. There is, of course, a fundamental fault with this process, arising out of the fact that the chlorination of ethylbenzene normally yields a mixture of monochloroethylbenzenes very high in the α compound. Before the production of styrene could be accomplished on any substantial scale at a reasonable cost, the yield of styrene from both the α and β compounds had to be materially increased.

In another laboratory, work was being done simultaneously on the process now used by us for making styrene, which does not involve a chlorination step. At one stage of the development the two processes appeared to present substantially equal possibilities, and we were confronted with the question of which process to concentrate upon in an endeavour to produce the material. Let us assume for a moment that the process involving chlorination could have been worked out to produce styrene at the same cost as the one now used and that we had elected to develop this process. When the present need for styrene arose, we should have found ourselves with a process requiring huge quantities of chlorine which might well have forced the production of a polymeric elastomer probably inferior to the styrene-butadiene type because of lack of sufficient styrene. It should be added that work was continued on the process involving the chlorination step for some time after the decision to use the cracking process was made. However, such work only substantiated the correctness of our decision, in that we ultimately found better economies were actually obtained by the cracking method.

Manufacturing Methods

The story of the development of our present commercial method for the manufacture of styrene begins in 1933. Considerable research on the cracking of hydrocarbons to yield unsaturates such as ethylene had been in progress for some time in our laboratories. At least three methods had been worked out. A group of research workers, not associated with the cracking problem, had been in a position to observe most of this work. Some of these men were experienced organic chemists, and the thought of large quantities of relatively inexpensive ethylene stimulated their imagination; they had accumulated a store of knowledge on the Friedel-Crafts reaction, and they could see the possibility of cheap ethylbenzene.

Before their eyes were satisfactory cracking processes, and the possibility of dehydrogenating ethylbenzene to styrene seemed to merit investigation. The problem was fully recognised and the solution appeared to be reasonably simple. It was not! It required over three years and the efforts of a large group of chemists and engineers to work out the process to the point where a satisfactory product was obtained.

The ethylbenzene reaction did not require too much time and effort, and the basic work on producing this intermediate material was completed in two or three months. A great deal of subsequent research was necessary to perfect the process and make it commercially useful. Various cracking procedures were tried, and then concentrated effort was put into the process, involving mixing the preheated vapours of ethylbenzene with highly superheated steam. It was found that high yields could be obtained by this procedure without producing free carbon or tar in the condensed reaction product.

Purification

The next step was the separation of the styrene from other products of pyrolysis. This purification was a tedious problem, and in many instances we thought it was solved only to discover that the polymer formed from monomer we thought pure would still bluish and craze. In one instance it was reported the problem was solved. Some days later this proved to be the story: Five gallons of the best monomer were taken to an excellent still, and an attempt made to clean up the product once and for all. The run was made under ideal conditions, and the product was analysed at short intervals by the bromide-bromate titration method for unsaturates. When the analysis showed a purity of over 99.9 per cent., this fact was reported. No immediate report was made that the purity ultimately went to 104 per cent. That is how the presence, till then undetected, of phenylacetylene was recognised. Monomer purity is the most important single thing to be considered in the preparation of styrene polymers and copolymers, particularly the styrene-butadiene copolymer.

The Danger of Discoloration

On hot working the polymer in moulding and compounding operations, we sometimes get molecular degradation with a consequent viscosity decrease and loss of strength and toughness. Also, we occasionally have the problem of discoloration on drying the polymer to remove the last traces of monomeric styrene. Investigation of this problem revealed that certain hydrocarbon-substituted catechols prevent such discoloration and degradation, and permit reproducibility of properties in polymers. As a safety measure, therefore, we have found it advis-

able to incorporate *tert*-butyl catechol, in the order of 1 part in 20,000 parts of monomeric styrene, as a stabiliser.

It was necessary early in the development to determine the probable toxicity of the monomer. We find that monomeric styrene may be handled with the same precautions now observed in the handling of common aromatic hydrocarbon solvents. It is worth noting that the extreme eye and nose irritation produced in man at a concentration of 1300 parts per million affords a definite safeguard against voluntary exposure to acutely hazardous concentrations of monomeric styrene vapour. Concentrations up to 400 p.p.m. do not produce appreciable eye and nose irritations in man and appear to present no serious industrial hazard; therefore this figure is suggested tentatively as the permissible limit for repeated exposures.

Comparison of Methods

It is interesting to make a brief comparison of the Dow method with some of the other processes considered for the production of ethylbenzene to be used in making styrene. One proposed process utilises benzene and 96 per cent. alcohol as starting materials. These are reacted in the presence of a solid catalyst containing phosphoric acid at temperatures around 315°C. and pressures of the order of 250 lb./sq. in. Another process is similar, except that ethylene is substituted for alcohol. In both of these processes benzene and ethylene must be recycled several times, and the yield of ethylbenzene is claimed to be about 200 lb. per lb. of catalyst. Both processes require nitration-grade sulphur-free benzene, which has a 0.5°C. boiling range. In contrast to such processes, the one we have developed will actually use ethylene in admixture with other hydrocarbons in concentrations as low as 38 per cent. ethylene, provided the gas is nearly propylene-free. Of course, a more concentrated ethylene is desirable if it can be economically obtained. The operating temperature of our process is only about 88°C., and the pressure is relatively low, 15 lb. gauge. Aluminium chloride is used as a catalyst, and 75-100 lb. of ethylbenzene can be obtained per lb. of catalyst with a nitration grade of benzene. Scrap aluminium can be used in preparing a satisfactory catalyst, as well as cheap bauxite. Our process can use a less pure benzene with a boiling range of 1°C., with no substantial adverse effect on the quantity of ethylbenzene obtained per lb. of catalyst.

The presence of sulphur in the benzene is not objectionable in our process, inasmuch as the aluminium chloride catalyst used promotes the formation of hydrogen sulphide gas which is vented from the system. Small amounts of unsaturates can also be tolerated in the benzene. The yield of ethylbenzene which can be obtained by operating accord-

ing to our continuous procedure is nearly theoretical. No ethylene is recycled in the Dow process. A particular advantage arises out of the substantial dealkylation of any polyethylbenzenes formed simultaneously with monoethylbenzene. Procedures satisfactorily worked out on a pilot plant scale for recovering as much as 80 per cent. of the spent aluminium chloride catalyst, are now being extended to commercial plant operation.

Although over 95 per cent. of our present production of polystyrene is going directly

into war uses, styrene is distinctly not a "war baby." It will continue to find use as a basic material in elastomers. We visualise the refinement of the material and its expanding use as a mouldable thermoplastic. It is peculiarly adapted to fabrication by injection moulding. It is strong, tough, and exceedingly attractive because of its crystal clarity as well as its unlimited colour possibilities. We look forward confidently to the future of styrene in the radical improvements in consumer goods which peace will bring.

The Planning of Science

January Conference

SIR STAFFORD CRIPPS and Sir Robert Watson-Watt will be the main speakers at a conference of scientists which will be held at Caxton Hall, Westminster, early in the New Year. The Association of Scientific Workers is calling this conference to discuss the much debated subject of the "Planning of Science—in War and in Peace." Scientists who have been working on the new weapons for the 1943 offensive will meet to consider better means of liaison. Greater co-ordination is still necessary to relate weapon design to the ever-changing requirements of the Forces, to avoid overlapping of research, and to anticipate and prepare for technical problems likely to arise as the war develops. A central planning board for science would for the first time give working scientists an opportunity of transmitting rapidly to official quarters the ideas for technical advance which can make that vital difference to our war effort.

The first session, on Saturday afternoon, January 30, will deal with the "Central Direction of Science," and in addition to Sir Robert Watson-Watt and Sir Stafford Cripps, there will be speakers on the war-time organisation of science in the U.S.A. which has many lessons to teach us in regard to the gearing of science to the war machine, and in the U.S.S.R. which has built its industry on planned science. Speakers in the second session, on Sunday morning, January 31, will come straight from the factories and laboratories. Mr. W. C. Devereux, managing director of High Duty Alloys, and Mr. Ben Smith, National Organiser of the A.Sc.W., will speak on the relation between managements and scientific staff as it affects production. The final session, on the Sunday afternoon, will deal with planning for the post-war period. Professor J. D. Bernal will be in the chair; Professor P. M. S. Blackett will deal with the planned use of science in preparation for the peace; and Sir Lawrence Bragg will deal with the rehabilitation of scientists after the war.

Moroccan Oil Supplies

Locally Produced Lubricants

EXPERIMENT on a considerable scale to increase the use of vegetable oils for lubricants is taking place in Morocco. Potential sources of lubricating oils and greases, as explored by Moroccan industrialists, are: (1) Liquid vegetable oils, such as olive, peanut, colza, castor, raisin seed, and resin; (2) solid vegetable fats like copra, palm, and karite oil; (3) animal liquid oils, such as neatsfoot, and fish oil; (4) solid animal greases, such as tallow; and (5) mineral liquid oils from coal, lignite, or peat, and even water.

Investigation of this output in Morocco indicates that an oil should be evaluated in the light of its viscosity, oiliness, adhesiveness, and film resistance. Its action on metals, its oxidising resistance, non-thickening qualities, non-inflammability, and volatility should also be studied.

Liquid vegetable oils, including peanut, have much less viscosity than mineral oils. The most viscous is castor oil, but all oils can be thickened by aeration. Vegetable oils adhere better to metallic surfaces than do mineral oils; they offer a film resistance superior to a petroleum oil of the same viscosity; but they have less resistance to oxidation. The introduction of oxidising reagents and air treatment reduces notable thickening tendencies. Olive, peanut, and colza oils solidify at much higher temperatures than the solid vegetable oils. In brief, vegetable oils have lubricating qualities superior to mineral oils, but they are more susceptible to temperature changes and deterioration from oxidation.

Of the solid vegetable oils, neither copra nor palm oil can replace greases, because of their low melting points and their variability under different temperatures, but they can be employed in soap manufacture. Liquid animal oils, such as neatsfoot oil, are almost wholly used by the Moroccan textile and tanning industries. They have, generally speaking, the same excellent lubricating qualities and the same defects as liquid vegetable oils.

New Control Orders

Coal Tar Products

THE Control of Coal Tar Naphtha and Xylole Order, 1942 (S. R. & O. 1942, No. 2508, price 3d.), which came into force on December 21, revokes the Coal Tar Naphtha and Xylole Order which was summarised in our issue of February 21, 1942 (p. 102). In common with the previous Order, it controls the acquisition and disposal of naphtha and xylole in quantity. Excepted from the Order are the disposal and acquisition, at any one time, of quantities of naphtha not exceeding 100 gallons, and of xylole not exceeding 50 gallons, with similar quarterly limits of 200 gallons for naphtha and 100 gallons for xylole. Furthermore, the Order does not apply to the importation of the controlled products into the United Kingdom, nor does it apply to Northern Ireland. No dealings in quantities greater than the above of the controlled products are permitted except under licence. Arrangements for blending are subject to directions from the Minister of Fuel and Power; and a schedule of prices is fixed by the same Minister.

Delivered prices for the controlled products are contained in the "Second Schedule" to the Order; specified deductions from the above prices when the buyer takes delivery at seller's premises are included in the "Third Schedule"; and increases per gallon in respect of sale or supply in drums are included in the "Fourth Schedule."

Prices are regulated according to grade (five grades of naphtha, and three of xylole) and to quantity supplied (varying from quantities of under 20 gallons to quantities of over 1000 gallons). The grades shall, in the case of naphtha, be determined according to the applicable distillation range set out on pages 27-35 of "Standard Specifications for Benzol and Allied Products" (1938); and, in the case of xylole, be determined according to the difference in degrees centigrade between the temperatures (running points) at which, when 100 ml. of the xylole are tested by the standard method, 5 ml. and 95 ml. of distillate have been collected, the temperature range being between 135° and 148°C.

In this Order, "coal tar naphtha" means any liquid, not being xylole, derived from coal of which, when tested by the standard method, not more than 5 per cent. shall have distilled when the temperature has reached 125°C. (running point) and not less than 90 per cent. shall have distilled when the temperature has reached 200°C. (stop point), and which consists of at least 80 per cent. of hydrocarbons, and which contains not more than the per cent. by volume of toluene specified in the Control of Toluene Order for the time being in force; and

"xylole" means any liquid derived from coal of which, when tested by the standard method, the difference between the temperature (running points) at which not more than 5 per cent. or less than 95 per cent. distills shall not exceed 10°C., the temperature range being between 135° and 148°C., and which consists of at least 80 per cent. of hydrocarbons, and which contains not more than the per cent. by volume of toluene specified in the Control of Toluene Order for the time being in force.

Prices of Coal-Tar Products

The Coal-Tar Products Prices Order, 1942 (S. R. & O. 1942, No. 2509) which came into force on January 1, 1943, is divided into six parts. Parts I-III which cover price control of anthracene, naphthalene, and road tar, are very similar to S. R. & O. 1942, Nos. 733, 736 and 659, which they supersede. Part IV, which replaces the Coal Tar Acids Prices (Inland) Order (S. R. & O. 1942, No. 731), has been extended to embrace coal tar acids sold or supplied for delivery to a buyer in the U.S.A. An Article has been incorporated enumerating the charges which may be added to the schedule prices in respect of coal tar acids sold for delivery in America. Minor changes have also been made in the schedules and in the methods of test. Part V covers price control of creosote oil for hydrogenation purposes. No person shall, except under permit, sell or supply any creosote oil for the purpose of hydrogenation, (1) other than at the fixed ex-works price, (2) unless the oil conforms to the characteristics mentioned in the Order. The Order contains provisions enabling creosote oil not conforming to the characteristics mentioned in the Order to be sold for hydrogenation purposes under permit and at the price quoted in the permit. Part VI contains general provisions. All communications should be addressed to the Coal Tar Control, Quebec House, Quebec Street, Leeds, 1.

Mica Clay

The Board of Trade are issuing the Production of China Clay (Restriction) Order, 1942 (S. R. & O. 1942, No. 2604). This Order replaces the Production and Supply of China Clay (Restriction) Order, 1942, and its purpose is to bring under control, by means of licensing, the production of mica clay in addition to china clay.

Sale of Molasses

The Control of Molasses and Industrial Alcohol (No. 17) Order, 1942 (S. R. & O. 1942, No. 2608), which came into force on December 28, makes a number of minor alterations in the conditions relating to the sale of molasses. To save work, details of carriage and storage charges need no longer be given separately in the invoice to the

farmer, but must be furnished on request. The invoice may include a reasonable charge for credit where given. There is no change in the basic prices to consumers.

Carriage Paid

Traders are reminded that, as announced early in November, traffic by merchandise train must be sent "carriage paid" as from January 1. This means that the consignor must be responsible for paying carriage charges at the forwarding station but does not involve pre-payment if the consignor has an authorised credit account with the railway. If serious difficulties arise they should be discussed as soon as possible with the appropriate district goods officer of the railway company concerned. The Order, entitled "Railways (Carriage Paid) Direction, 1942," S. R. & O. 1942, No. 2578, has now been made, and as soon as it has been printed copies may be obtained from H.M. Stationery Offices in the usual way.

Personal Notes

MR. F. A. SPENCE BROWN has joined the board of Johnson, Matthey and Co., Ltd.

MESSRS. H. G. PIPER, W. H. BAILEY, and R. S. WALDE have joined the board of Victor Blagden & Co., chemical merchants.

DR. RONALD TASKER, of the Burmah Oil Company, is reported missing as the result of enemy action at sea in November last.

MR. V. G. BARTRAM, president of Shawinigan Chemicals, Ltd., has been elected a director of the Canadian Liquid Air Company, Ltd.

DR. JOHN C. BRIDGE retired from the post of Senior Medical Inspector of Factories on December 31 and will be succeeded by DR. E. R. A. MEREWETHER.

WING-COMMANDER E. A. HOWELL, D.F.C., R.A.F.V.R., who has been awarded the O.B.E. for distinguished services, was working, before he joined up, at Glasgow University where he graduated B.Sc. with honours in chemistry. He was a native of Paisley.

MR. JAMES G. FORBES is reported to have been interned by the Japanese in Shanghai along with other members of the I.C.I. staff there. This news is dated November 5 and indicates that the men interned are well and as comfortable as is possible. Mr. Forbes has been with the I.C.I. at Shanghai for 12 years on their Shanghai staff and was formerly a Lieutenant in the Shanghai Volunteer Corps.

Obituary

MR. J. W. BENTLEY, who was a partner in Thomas Bentley and Son, soap manufacturers, of Brookfoot Mills, Woodside, Horsforth, has died, aged 64.

DR. FRANK DAWSON ADAMS, F.R.S., who died at Montreal on December 26, was distinguished in the sphere of metallurgy, and especially of geology, in Canada. Formerly Vice-President, and Dean of the Faculty of Applied Science, at McGill University, he had served as President of the Canadian Institute of Mining and Metallurgy in 1910-11, and was President of the Royal Society of Canada in 1913. He was also an honorary member of the Institute of Mining and Metallurgy of Great Britain.

MR. WILLIAM FRENCH, whose death at Lancaster, at the age of 79, is announced, was the founder in 1933 of the Lancastrian Frankland Society. Educated in science at Cambridge and at the Royal School of Mines, he was senior science master at Bury Grammar School in 1892-1901, when he was appointed principal of the Storey Institute at Lancaster. Later he assisted Professor Liveing and Professor Dewar in their scientific work, and in 1912 was appointed secretary to Messrs. Joseph Storey & Co., Ltd., afterwards becoming managing director.

MR. ARTHUR RICHARD PAIN, who was associated for many years in a directorial capacity with the fortunes of THE CHEMICAL AGE, died on December 24 at Frimley, Surrey. A solicitor by profession, he volunteered early in the last war and saw active service in Gallipoli, the bad climate and rigorous conditions of that campaign leaving permanent ill effects on his health. In 1923, when Sir Ernest Benn invited him to become secretary of Benn Brothers, Limited. He served most successfully as secretary of the company during a period of considerable expansion and became a director in 1927. In 1934 he resigned the secretaryship to become chairman and managing director of Trade Promotion Trust, Ltd., though the board of Benn Brothers succeeded in retaining his services as a director for four years more.

DR. FREDERICK M. BECKET, formerly vice-president of the Union Carbide and Carbon Corporation with which he had been connected since 1906, died in New York on December 1, aged 67. A native of Montreal, Dr. Becket studied at McGill and Columbia Universities. For his achievements in metallurgy he received the Perkin Medal of the Associated Chemical and Electro-Chemical Society, 1924; the Acheson Medal of the Electro-Chemical Society, 1934; the Elliott Cresson Medal of the Franklin Institute, 1940; and a "Modern Pioneers" award of the National Association of Manufacturers, 1940. He was president of the Electro-Chemical Society in 1926, of the American Institute of Mining and Metallurgical Engineers in 1933, of the Chemists' Club in 1939, and was an active member of the Iron and Steel Institute of London.

General News

The Ministry of Food announces that there will be no change in the existing prices of oils and fats allocated to primary wholesalers and large trade users for the five weeks ending January 30.

The Control of Coal Tar (No. 3) Order, 1942 (S.R. & O. 1942, No. 2579), dated December 15, makes two small emendations to Article 33 of the No. 2 Order (see THE CHEMICAL AGE, November 7, p. 408).

The surface of a new giant globe, the gift of the U.S. Army to Mr. Churchill, is treated with lacquer which permits the use of a grease pencil. Soap and water will remove any markings of new fronts or frontiers.

During the past year, 10,000 more commercial vehicles have been equipped for gas motive power. Tanker accommodation to the extent of 40,000,000 gallons of petrol has been saved in this way.

An Order has been made (S.R. & O. 1942, No. 2463) providing for the registration of producers of any material specified in the Schedule to the Control of Stone, Slag, and Lime Order, 1941. No producer will be allowed to continue operations at any works after April 1 unless he holds a certificate.

If there is sufficient demand a new class in Electrodeposition will be started at the Birmingham Central Technical College after Christmas on Tuesday evenings, 6.30-8.30 p.m. The first class meeting will be held on January 5. Students should attend on that date at 6.15 for enrolment prior to the class.

A slight relaxation of the Control of Paper (No. 48) Order has been made which will permit anyone to affix a label to any package which has to be exported from the U.K., provided that the label was manufactured before September 14, 1942, for labelling packages for export.

The Rubber Sole and Heel Manufacturers' Association is issuing an appeal to boot and shoe repairers to save crepe rubber scrap. They emphasise the fact that, while all scrap rubber is of vital importance to the war effort, crepe rubber is ten times as valuable as any other.

A system of fracture treatment and rehabilitation, in connection with the Emergency Hospital Scheme, has been initiated for war workers by the Factory Welfare and Advisory Board of the Ministry of Labour. The Board asks for the co-operation of employers and trade unions in seeing that the facilities are widely used, and all interested should apply to the Ministry (8 St. James's Square, S.W.1) for Pamphlet PL 113/1942.

From Week to Week

Over £5000 had been spent in Eire in seven months in investigations into turf charcoal for making producer gas, said Mr. de Valera in a recent speech, and charcoal production was expected to start in the near future.

Foreign News

The use of tinfoil for packing insecticides has been prohibited in the U.S. by an amendment of the Tin Conservation Order, issued by the Director General of Operations.

To replace imports from the U.S.A. and U.K., the sodium carbonate deposits at Lake Urao, Venezuela, are being exploited. Increased transport costs, however, are interfering with the development of the project.

Swedish chemical trade for the first eight months of 1942 was valued at 114,900,000 kr. (imports) and 17,400,000 kr. (imports), as against 100,000,000 kr. and 22,800,000 kr. for the corresponding period in 1941.

The Canadian Carborundum Co., Ltd., is enlarging its plant at Niagara Falls, Ontario, according to trade reports. The additions, costing \$700,000, will include a new furnace building and several transformer buildings.

Extensive mica deposits near Durania, Santander, Colombia, are to be exploited by a private concession, in agreement with the Ministry of Mines, according to local Press reports.

The Tata company has contributed Rs. 830,000 to the new national chemical laboratory which is to be built at Poona, India, and the name of Tata will be associated with the new foundation.

Economists in China have invited a Czechoslovakian rubber expert to investigate the possibilities of establishing a synthetic rubber industry to replace industrial rubber, hitherto imported mainly from the United States.

Iron, copper, nickel, chrome, manganese, magnesium salts, bauxite, asbestos, graphite, coal, and oil deposits are among those discovered recently in the Ural district of Russia, according to a *Pravda* article summarised by the Moscow correspondent of *The Times*.

Lower production figures were shown by South African Alkali in all departments for the year ended June 30, 1942, largely owing to the lower rainfall at the pan. Brine pumped amounted to 13,586,400 gals. (against 14,130,000); brine refrigerated, 5,844,000 gals. (5,970,000); soda ash, 2390 tons (2635); salt, 3465 tons (3810). Net profit, however, rose from £7666 to £8779.

An experimental sponge-iron plant is to be built by the Republic Steel Corporation close to its new by-product coke works at Warren, near Youngstown, O. The plant will cost \$460,000, and will produce 100 tons of sponge-iron daily.

The world's largest magnesium plant, Basic Magnesium, Inc., is the latest of five important magnesium plants to begin production in the United States in 1942. The others are the Dow plant in Texas, the Ford plant in Michigan, the Permanente plant in California, and the New England Lime Co.'s Connecticut plant. All five were financed and are owned by the Government through the Defense Plant Corporation. Three more ferro-silicon plants and four electrolytic plants are under construction.

Forthcoming Events

The London section of the **Society of Chemical Industry** will meet jointly with the Food and Plastics Groups at the Royal Institution, Albemarle Street, W. 1, at 2.30 p.m., on **January 4**, for the Jubilee Memorial Lecture, which will be given by Professor E. K. Rideal, who will speak on "Catalytic Hydrogenation."

The Midlands Centre of the **Electrodepositors' Technical Society** will hold a meeting at the James Watt Memorial Institute, Great Charles Street, Birmingham, at 4.30 p.m., on **January 5**, when Mr. C. Wharrad will open a discussion on "Hard Chromium Plating."

A meeting of the Edinburgh and East Scotland Section of the **Society of Chemical Industry** will be held at 7.30 p.m. on **January 8**, at the North British Station Hotel, Edinburgh. Professor R. H. Hopkins, D.Sc., F.I.C., will speak on "Some Recent Advances in Biochemistry Applied to Brewing."

A meeting of the Leeds Area section of the **Institute of Chemistry**, jointly with the Yorkshire section of the **Society of Chemical Industry**, will be held at 6 p.m., on **January 11**, at the University of Leeds (entrance Woodhouse Lane), when Mr. H. Hollis, B.Sc., A.I.C., will present a paper on "The Functions of a Government Inspection Department in War-Time."

The London section of the **Institution of the Rubber Industry** will meet at 6.30 p.m., on **January 11**, at the Caxton Hall, Westminster, S.W.1, to hear Mr. T. R. Dawson, M.Sc., F.I.C., F.I.R.I., speak on "Organic Loading Fillers which Substitute Rubber."

There will be a joint meeting of the **Chemical Engineering Group** of the Society of Chemical Industry and the **Institution of Chemical Engineers**, at 2.30 p.m., on **January 12**, in the rooms of the Geological

Society, Burlington House, Piccadilly, W.1, when a paper on "Solvent Extraction of Lubricating Oils" will be presented by Dr. H. Ter Meulen.

The James Forrest Lecture of the **Institution of Civil Engineers** will take place on **January 12**, at 2 p.m., at the Institution, Great George Street, S.W.1. Sir Charles Darwin, K.B.E., will speak on "The Extreme Properties of Matter."

The Microbiological Panel has arranged a meeting of the Food Group of the **Society of Chemical Industry** and the **Society of Agricultural Bacteriologists**, which will be held at 2 p.m., on **January 13**, at Burlington House, Piccadilly, W.1. Mr. H. F. Clayton will speak on "Links in the Cytase Problem," and Dr. W. J. Dowson on "The Kinds of Bacteria which cause Disease in Plants, and the Types of Disease they Produce." Mr. L. J. Meanwell will speak on a Dairying Subject.

The **Pharmaceutical Society of Great Britain** will meet at 7 p.m. on **January 14**, at 17 Bloomsbury Square, W.C.1, when Mr. E. H. Cotton will speak on "Synthetic Rubbers."

Commercial Intelligence

The following are taken from printed reports, but we cannot be responsible for errors that may occur.

Bankruptcy Information

SUTCLIFFE, HARRY, Bluehills, Ibstone, Bucks., plastic manufacturer and consulting chemist. (R.O., 2/1/43.) Receiving order December 11. Creditor's petition.

Appointment of Liquidator

CHEMICAL AND GENERAL DISTRIBUTORS, LTD. (L., 2/1/43.) R. S. Ford (with a Committee of Inspection), Audrey House, Ely Place, E.C.1, appointed liquidator. December 7.

Company News

William Briggs and Sons, Ltd., announce a profit for the year to September 30, of £25,560 (£27,200), and a final dividend of 17½ per cent., making 22½ per cent.

New Companies Registered

Harold Hudson, Ltd. (377,896).—Private company. Capital: £100 in 100 shares of £1 each. General manufacturers, merchants, manufacturers' and merchants' agents, importers, exporters, manufacturers of and dealers in fertilisers, soaps, oils, etc. Subscribers: H. Hudson and Eva Hudson, 27 Southleigh Grove, Leeds, 11.

F. S. Salver and Company, Ltd. (377,965).—Private company. Capital: £100 in £1 shares. Wholesale and retail merchants, dealers in and reclaimers of waste material, metal and other scrap, chemists, engineers, etc. Director: B. N. Eason. Registered office: 18a Watford Way, N.4.

M. L. T. Products, Ltd. (377,869).—Private company. Capital: £500 in 500 shares of £1 each. Manufacturers and dealers in materials for purifying and softening water, manufacturers and dealers in pharmaceutical products and chemical substances, etc. Directors: E. Marshall, 56 Sturgess Road, Wokingham, Berks; H. J. Moss.

Plastic Specialities, Ltd. (377,871).—Private company. Capital: £5000 in 2000 ordinary shares of 1s. each and 4900 participating shares of £1 each. Manufacturers, specialists, and merchants in plastic materials and utensils of all kinds, engineers, chemists, general merchants, etc. Subscribers: P. D. Cheeseman, W. F. Leeks. Registered office: Kent House, 87 Regent Street, W.1.

Universal Foundry Supplies, Ltd. (377,882).—Private company. Capital: £10,000 in 10,000 shares of £1 each. Founders, importers and exporters of, dealers in and manufacturers of foundry, metallurgical and chemical requisites, compounds and preparations for use in the metal and engineering industry, etc. Subscribers: P. J. Manison, H. Frampton. Solicitors: Slaughter and May, 18 Austin Friars, E.C.

Asprey and Suchy, Ltd. (377,830).—Private company. Capital: £1500 in 1500 shares of £1 each. Electro-platers, electricians, mechanical and electrical engineers, chemical manufacturers, manufacturers of and dealers in oils, paints, varnishes, synthetic and plastic materials, etc. Directors: L. Asprey, 207 Sussex Gardens, W.2; Anne C. Asprey, Emmy Suchy, E. Nelson, R. W. Banks.

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Chemical and Allied Stocks and Shares

ALTHOUGH British funds tended to higher prices, and sentiment generally has been assisted by the war news, the volume of Stock Exchange business was again very moderate. Industrial securities showed firmness in the absence of much selling, and shares of chemical and allied companies reflected the prevailing tendency. At 36s. 6d. Imperial Chemical were 3d. above the level ruling a week ago, while at the time of writing, Lever & Unilever have improved from 33s. 3d. to 33s. 9d. Borax Consolidated were steady at close on 34s., and British Match had a firm appearance at 36s. 6d. Following their recent decline, Barry & Staines have made a further rally from 34s. 9d. to 35s. 6d., but elsewhere, Nairn & Greenwich moved back from 56s. 3d. to 55s. pending the dividend announcement. Shares of companies identified with plastics were again fairly active with Thomas De La Rue around 87s. British Industrial Plastics 2s. ordinary were 5s., and business up to 10s. 3d. was recorded in Erinoid 5s. shares. In other directions, dealings around 12s. 6d. were shown in Goodlass Wall.

Murex ordinary units attracted buyers and rose further to 102s. 6d. At this level the yield on the basis of the 20 per cent. distribution, which has ruled for some years, is very moderate; but on the other hand, actual earnings on the shares were shown by the last accounts to exceed 40 per cent. Many companies are, of course, following a conservative dividend policy, and there is unlikely to be any early relaxation of this. The building up of reserves has to be read in relation to the additional strength given to finances to meet the difficulties and changed conditions that will rule in the post-war period. Meanwhile, it should not be overlooked that the strength of the balance-sheet position plays an important part in governing the market value of shares of individual companies.

Business in British Drug Houses ranged from 22s. 6d. to 23s. 6d., while Monsanto Chemicals preference shares continued to be quoted at 22s. 6d., and W. J. Bush ordinary at 50s. Morgan Crucible 5½ per cent. and 5 per cent. preference were 25s. 7½d. and 23s. 1½d. respectively. B. Laporte were 71s. 3d., and Fisons 41s., but as in many directions, the shares were firmly held and in some cases might only be obtainable in any amount at higher prices than those indicated by current quotations. Among other securities, British

Aluminium have improved from 48s. 9d. to 49s. 3d., while at 71s. British Oxygen were within 3d. of the level current a week ago. At 77s. 9d., Birmid Industries were higher, as were Tube Investments at 91s., and Stewarts & Lloyds at 50s. 10 1/2d. Among smaller-priced issues, British Glues and Chemicals 4s. ordinary were 7s. 6d., and Low Temperature Carbonisation were around their par value of 2s. Elsewhere, British Tar Products changed hands up to 9s. 1 1/2d., and British Emulsifiers 2s. shares up to 3s. At 73s. Turner & Newall were only slightly lower on balance despite the deduction of the dividend from the price.

Associated Cement shares had an easier appearance at 53s. 9d., but steadiness was maintained in British Plaster Board at 27s. Boots Drug 5s. ordinary were also steady at 38s. 3d., Sangers 19s. 9d., and Timothy Whites 24s. 7 1/2d. The units of the Distillers Co. were firm at 84s. 6d., United Molasses 29s. 1 1/2d., and Triplex Glass 30s. 9d. At 32s. 9d. Wall Paper deferred were 5d. better on balance, and Pinchin Johnson moved up from 30s. 6d. to 31s. 3d., but on the other hand International Paint eased from 105s. to 103s. 9d. In other directions, Lawes (chemical) were 8s. 9d., and Cellon 5s. ordinary 17s. 6d. Oil shares showed further response to the trend of the war news, Anglo-Iranian being 79s. 4 1/2d., compared with 78s. 9d. a week ago, "Shell" 66s. 3d. compared with 64s. 9d., and Burmah Oil have risen from 55s. to 58s. 1 1/2d.

British Chemical Prices

Market Reports

TRADE in general chemicals is reported to be steady and a fair weight of new business has been transacted, while contracts are being steadily drawn against by consumers. Values in most sections of the market remain firm. Sustained pressure for supplies of bicarbonate of soda and chlorate of soda is reported, and a steady demand is maintained for bichromate of soda and hyposulphate of soda. There are no important changes in the potash section, where supplies of yellow prussiate continue scarce and ready outlets are found for available quantities of caustic potash and bichromate of potash. In other directions formaldehyde is a good market and a steady demand is reported for white powdered arsenic. In the acid section values continue strong. Firm price conditions are the main feature of the coal-tar products market with creosote oil, carbolic acid, and cresylic acid in good request. The provisions of the Coal Tar Naphtha and Xylole Order, which has now been published, closely follow the proposals discussed with the trade interests. The Order came into operation on December 21.

MANCHESTER.—Strong price conditions are

the general rule on the Manchester chemical market, where business has been resumed after the holidays on a quiet note, though contract deliveries in most departments are going forward steadily. This applies particularly to the general run of the soda compounds, as well as to the ammonia and magnesia products, and the heavy acids. Among the tar products, also, although no great activity is indicated from the point of view of fresh buying, there is a satisfactory movement into consumption. The controlled prices for naphtha and xylole are now available.

GLASGOW.—In the Scottish heavy chemical trade there is no change from last week for home business. Export trade is still very restricted. Prices generally remain very firm with a tendency to a further rise at the beginning of the New Year.

Price Changes

Naphtha.—Solvent, 90/160°, 2s. 8d. per gal. for 1000-gal. lots; heavy, 90/190°, 2s. 2d. per gal. for 1000-gal. lots, d/d. Drums extra; higher prices for smaller lots. Controlled prices.

Xylole.—For 1000-gal. lots, 3s. 1 1/2d. to 3s. 4d. per gal., according to grade, d/d. Drums extra; higher prices for smaller lots. Controlled prices.

Ordnance Works Control

"Dictatorship" Not Acceptable

THE recommendation of the Commons Select Committee on National Expenditure that the whole of the responsibility for administration, maintenance, and production in Royal Ordnance Factories should be vested in one person is not acceptable to the Government.

The official reply is that the proposal is not considered prudent in existing circumstances, when the magnitude of the task is enough to absorb the full energies of two Directors-General. To overcome the difficulties arising from the present arrangement, it is proposed to give the Director-General of Ordnance Factories (Filling) a separate administrative staff.

The Ministry does not agree that the existing surplus capacity in Royal Ordnance Factories is excessive, and points out that a constant watch is kept on the position. It accepts a recommendation that an immediate joint survey of Royal Ordnance Factories should be made by the Ministry of Supply and the Ministry of Labour to secure the expeditious transference of workers who are already, or soon will be, surplus to requirements. As to the suggestion that stocks of materials and components should be accumulated to secure a proper flow of supplies, it states that this is the accepted policy and that, in spite of difficulties,

stocks of balanced sets of components are substantially higher than they were six months ago. The Ministry also states that the extension of co-ordination of inspection is being continuously explored and certain aspects of the problem are being examined by the Minister of Production.

To the suggestion that greater efforts should be made by headquarters to reduce the present rate of absence from work, the Ministry of Supply states that returns of absence from work are now on a uniform basis, are regularly available, and are constantly watched. In the last eight months the rates of casual absence have been substantially reduced. There are practical difficulties, it is stated, in carrying into immediate effect in all factories the recommendation to impose the limits accepted by the Government for hours of work, but it is accepted as a goal to be reached as soon as possible. In 38 out of 42 factories hours for men have been reduced to 60 or less, and in 39 women are working 55 hours or less.

Mr. E. V. EVANS, O.B.E., F.I.C., President of the Institution of Gas Engineers and general manager of the South Metropolitan Gas Company, Ltd., has been appointed an additional director of the company.

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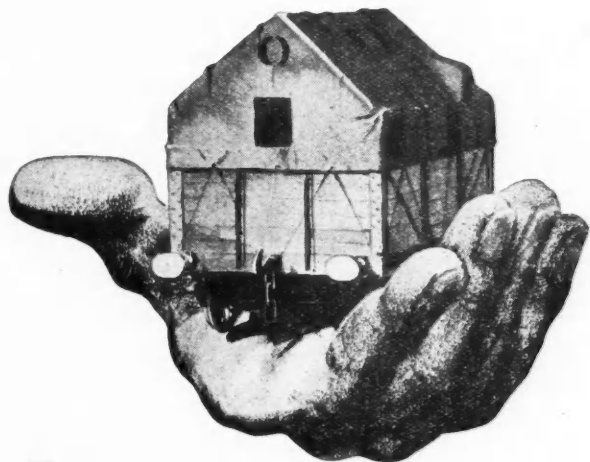
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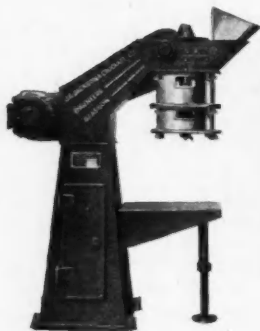
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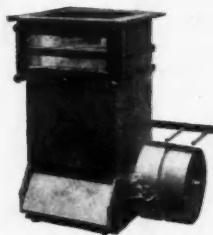
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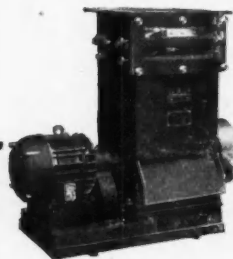
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